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Fall has come, and with it the lengthening hours of darkness, which mean additional station loads and a general increase of business among electric light station people and manufacturers. It is pleasant to note that the new season holds forth every promise of the greatest activity in every department. Throughout the country enlargements and repairs have been made, and in many places new plants have been erected to take care of the increased fall and winter business. It is believed that a number of interesting experiments, or trials, rather, will be made this winter, among them a considerable extension of the series enclosed alternating arc-light system and the Nernst lamp. The present outlook for the winter is the brightest that has been before the electric lighting industry for many years.

ELECTRICITY AND POPULATION.

It is noticeable to those who study the statistics of the census that the rate of increase of our larger cities is becoming less, and while the ratio of urban population is larger than it ever was before in the history of the country, yet if one puts aside the false data due to the enlargement of city boundaries and the absorption of suburban districts within municipal limits, it is very noticeable that the rate of increase of population in the denser centres has become less.

The reason for this is found in the general extension of two applications of electricity, while a third has played no inconsiderable part. The trolley car has been perhaps the largest agent in the redistribution of population, making it possible for the people who work in the crowded districts of cities to live at considerable distances away and enjoy the very great advantages of suburban life. This is particularly noticeable in cities of the intermediate size. Twenty years ago cities of the second class were much condensed in area, for the reason that practically every one walked to and from his place of work, and for this reason the residence areas crowded upon the business districts as closely as possible. The horse car of those days was at best a poor thing, and it was not until the coming of the swifter trolley that it was possible for the ordinary man of business or laborer to live more than half a mile, or such a matter, from the scene of his daily task. To-day all this is changed, and as a consequence the residence district in all such cities has vastly extended, and people not uncommonly live anywhere from ten to twenty miles away from their places of business.

To double the radius of a city means to increase its area four times. The trolley, by its duplication and triplication of the city radius, has enabled very large territories to be included in the suburban districts of towns, with the result that houses have plenty of room around them, the people are no longer compelled to live close together, and to this degree a very important social revolution has been wrought, and, indeed, is still in process of extension. No one can deny the benefits of a freer life and the immense social, sanitary and other advantages which have followed the introduction of the trolley car, and the consequent extension of residence neighborhoods.

But another agency has not been idle. The principal objection to country life has been its loneliness and the absence of those conveniences which differentiate the city house from the country residence. The loneliness, by which is meant the lack of intercourse with neighbors, has been in a great degree removed by the telephone. Perhaps the best work that the independent telephone movement has accomplished has been the popularization of the telephone and its introduction at low rates into sparsely settled neighborhoods, thus removing the bugbear of isolation which has been so long a complaint of the rural resident. But the telephone has done more for those living in the country and in the country districts surrounding cities than to furnish them a means for social conversation. It has proved itself a very practical and valuable addition to the farmer's means for making a living. By putting him in immediate touch with his markets, whether for selling or for buying, it enables him to conduct his business in a much more businesslike way than formerly, when the isolated gardener or truckman loaded his vehicle in the early hours of the morning with the produce of his fields and drove to town without the slightest idea of what he would receive for it or whether he could sell it at all.

With the telephone nullifying the isolation of the country districts and the trolley car providing quick and inexpensive means of transit, the suburbs have become, in a sense, part of the town. It is no

longer a case of *rus in urbe,* but rather the reverse; for the town has gone into the country and carried with it those two important agencies, while not far behind comes the electric light, making at once more pleasant and more safe the highways and lanes of the country districts.

While isolation was annoying under the older régime, it also had its dangers on account of the exposure of valuable property in suburban districts to the attacks of those who prowl by night. Everybody knows that one arc light is as good as two policemen, and thus the extension of electric light in the suburban districts has made them better places of residence in two distinct ways.

It is unnecessary to seek further the reasons for the decentralization of population, or the extension territorially of cities, or the increasing army of people who have left the town for the country so far as their places of abode are concerned. And yet it is conceivable that we have seen only the beginning of the changes which inevitably will follow the extension of electrical utilities, and we may even look forward to the practical disappearance of cities as places of residence in the future and the redistribution of population in a more satisfactory, sanitary and altogether desirable way through the effect of the electrical agencies referred to above.

The meeting of the Association of Edison Illuminating Companies, held at Buffalo this week, of which an account will be found in other columns of this issue, was an interesting occasion on many accounts. This organization represents the companies that were the pioneers in electrical work in the United States, and perhaps shows the development of the American idea more distinctly than any other similar association. It will be remembered that Mr. Edison himself regards the central station as his greatest invention. To what an extent this business has grown since its inception in his mind, less than twenty years ago, and how important an industry electric lighting from central stations has become in our larger cities, is a familiar story to all electrical people. The companies represented are among the strongest of their class. These annual meetings devoted to the interchange of ideas and experiences have always proven of high benefit to those participating in them, and certainly this year's meeting was no exception to that rule.

PULL AND PUSH.

On all sides the statement is made, time and time again, that a young man has no chance in the electrical field without what is ordinarily denoted by the term "pull." A little analysis of this subject may be of interest. Biographies of great men in all lines of human endeavor who have risen from extremely humble positions in life to those of world-wide eminence are familiar to all of us. These men, for the most part, had no influence, but only their own ability, coupled with habits of great industry, to aid them on their path of ascent.

To be sure, the ranks of all our professions and different lines of business are overcrowded, but there is always room for another man who possesses ability and is willing to work. On the other hand, there is no room for him who comes to his place of business with the intention of doing as little as possible and expects to rise in this manner.

Time was—and but a few years ago—when the opportunities for success in the electrical professions were immensely greater than those in almost any other field. It was a new subject and there were very few people who knew anything about it. Consequently, the opportunities for those who had even a very limited knowledge of electricity were correspondingly great. But this is all changed today. The hundreds of young men which our numerous scientific and technical schools are annually turning out have made competition as sharp in this field as in any other. Still, the expansion of this business, which is the most rapid that the world has ever seen, presents untold opportunities for whomsoever is prepared to grasp them. In preparation for this he must not forget that it is absolutely essential for him to secure as much preliminary training as lies within his means. Much of it may seem a waste of time, but it will all be useful and make him better off than many of his competitors when he begins his real life work.

One of the most potent reasons for expecting that great progress will be made in the practical application of electrical methods to all features of human advancement is the international character of many of the meetings of the electrical societies of the world. At these meetings men from almost all parts of the globe gather together and increase their efficiency by contributing to the general knowledge of the subject and receiving aid and inspiration from their coworkers. Great progress in almost any object of human endeavor has almost never been accomplished by one person working alone, but it is the united labor of all which assures great and permanent advancement.

THE STREET RAILWAY CONVENTION.

The annual convention of the American Street Railway Association, which is to be held in the Madison Square Garden, in New York city, October 9, 10 and 11, bids fair to rival in interest and importance any preceding meeting of this very influential body. The street railway industry in the United States is one that has been of rapid growth, but of the most solid and permanent character. It would be interesting to know accurately how much investment is represented in electric street railway lines in North America, but it is well known that an astonishing sum has been expended in this direction, and that the street railway industry as a whole is one that ranks in the first class as regards both capital invested and dividends paid.

The assemblage of the men who have laid the foundations of this great industry is in itself an interesting occasion, but it is likely that this time, as on many past occasions, papers of great interest and value will be presented. Indeed, at no other meetings, save those of the American Institute of Electrical Engineers, are more important electrical papers read than at these gatherings of the Street Railway Association. In addition to the papers and discussions there will be an exhibit of electric street railway apparatus which, judging by past years, will be of high importance and great value. It is interesting to note that the vast space of the Madison Square Garden has all been taken for exhibition purposes, and it is believed that the occasion will call forth a display of electrical apparatus second to none that has been held in the United States.

THE CHAMBLY-MONTREAL TRANSMISSION.

Elsewhere in this issue will be found an extended description of one of the most interesting power-transmission plants in North America—that which supplies a considerable proportion of the light and motive power used in the city of Montreal from the falls on the Richelieu River at Chambly, Quebec. The interest of this fine installation lies in the transmission line itself and in the method of compensating the low power-factor due to lagging currents and the method of protection against lightning.

It is always interesting to see a deduction originally purely analytical made the basis of practical work of importance. The fact that over-excited synchronous apparatus would impart leading currents to the line with which it is connected or compensate out lagging currents has long been known, but its application has not often been practised, especially on such a scale as is exhibited in this transmission line. Notwithstanding the fact that the large total of six thousand horsepower in motors is operated upon the secondary distributing system in Montreal, the power-factor of the line has been held so nearly unity as practically to cause no trouble of any kind, and the full utility of the plant has been made available without excessive cost. It is also of interest to note that in four years of operation, generating directly a potential as high as twelve thousand volts in the dynamos, there has been no accident worthy of the name from electrical causes. This is practically a demonstration of the permanence of high-tension apparatus, and shows that its depreciation is nowhere nearly so high as was expected at the time the plant was laid down.

Occasion was taken in these columns last week to refer to the barbed-wire lightning protection which has proved so entirely successful upon this line. It seems somewhat astonishing to see a transmission line upon which so much depends absolutely devoid of the usual lightning-arrester apparatus. Experience, however, is the best teacher, and the protection which has been obtained from the simple barbed fence wire has proven entirely adequate and, indeed, superior probably to that which could have been had from other and more elaborate appliances. While this is in no sense an argument against the lightning arrester as ordinarily constructed it is certainly interesting to those who have to maintain long-distance high-tension transmission lines, and it suggests an easily applied and obvious remedy for many of the troubles that have beset such installations. Of course, it is not possible to use barbed wire in all situations, and there is a wide field for the lightning arrester; but for the cross-country line it seems that the experience of the Chambly-Montreal line has shown that the barbed wire is perhaps the best protection yet discovered, and certainly the simplicity and ease of application of this form of lightning guard will commend it.

Another very interesting feature of this plant is the load-curve and the method whereby the extraordinary result of an average day load, over ninety per cent of the extreme peak, is secured. A great many lighting and power installations might benefit themselves immensely by a study of the methods which Mr. Gossler has put in operation at Montreal for the distribution of his power load through the daylight hours. He discovered that when manufacturers and other power users were properly approached, they and their operatives as well were willing so to arrange the hours of work that the motor load could go off before the lighting load of the evening begun. It should be remembered that probably this is more difficult in the latitude of Montreal than it would be in places further south, where the variations in the length of the day are not so marked. In December in that latitude darkness comes very early, but it was found that the operatives were willing to work longer hours in the summer time and to do practically all the work that was to be done by daylight. Of course, this result was not obtained without concessions in the rates of charge for power, but the fact that it was obtained shows its possibility and should prove highly suggestive to the management of electricity supply stations elsewhere.

With its two fine transmission plants, the one referred to above and that bringing in current from the Lachine Rapids, Montreal is a centre of peculiar electrical interest. The city is already a manufacturing centre of great importance, and it is believed that its future will exhibit a considerable enlargement of manufacturing enterprise due to the abundant and cheap power which is now available throughout its limits.

AN ECONOMICAL SWISS INSTALLATION.

On other pages of this issue will be found an illustrated description of an installation in the eastern part of Switzerland, which, although its size is very small, possesses many features of great interest. The little plant shows how correct engineering design can be exhibited in small installations and how apparently insignificant sources of power may be turned to advantage.

There are many places in this country where small water power exists and where installations similar to that at Alstaetten could be put down with excellent results. We are, perhaps, as a nation rather prone to magnify the importance in size in engineering installations and to overlook the opportunity which is frequently afforded by small plants for the display of those qualities of good judgment which constitute the best engineering. Perhaps as good a definition of engineering as may be given is the production of the greatest result from the least expenditure of money and labor. We are often carried away by spectacular feats of engineering, combining generally elements of great magnitude or apparent difficulty, but far too little praise is given to the small plants which thoroughly fulfill the condition laid down in the definition given above and prove profitable to their owners.

A study of the little plant described by Signor Bignami may prove profitable as well as interesting. A seemingly insignificant stream of water is impounded and made to do work enough to light a small town and drive a few trolley cars for local passenger service. At the same time this small installation pays a good dividend to its owners and accomplishes a very useful function in the neighborhood in which it is situated. Such work, although small, seems to bear the stamp of the best engineering because natural conditions are seized upon and availed of to produce an altogether desirable result.

Science Brevities

Radiation of Uranium at Low Temperature—M. H. Becquerel showed some years ago that the radiation was independent of temperature. He has carried out further experiments over a wider range of temperature between 100 degrees and minus 20 degrees. The enlarged limits of these observations demonstrate that this radiation remains practically constant in intensity for all the temperatures observed.—*Comptes Rendus,* July 22.

A New Element: Victorium—An account of his discovery of the new element which he calls victorium has recently been given by Sir William Crookes, F. R. S., to the Royal Society. It has a pale brown color, and dissolves easily in acids. Its oxide is less basic than that of yttrium, but more so than the greater part of the earths of the terbium group. The chemical properties of victorium differ in many respects from those of yttrium, but, generally speaking, it may be said to occupy an intermediate position between this element and terbium. It is admitted that the oxide of victorium has the formula Ve_2O_3, its atomic weight is not far from 17. The photograph of the spectrum given by the oxide shows certain definite lines which have not been observed with any other body. The spectrum is obtained by the incandescence of the body in a vacuum tube; the light given off has been analyzed by a spectroscope of great precision, and the exposure upon a photographic plate shows a series of interesting rays in the ultra-violet region. In order to examine the negative an apparatus has been constructed which will measure to the one-hundred-thousandth of an inch.

Luminous and Vibratory Electrical Effects—An interesting series of experiments relating to the vibrations and luminous effects produced in metallic wires by a Wimshurst machine has been made by M. D. Negreans, of Paris. If one pole of the machine is connected to a wire stretched, insulated and contained in a tube, the other pole of the machine being connected to earth, the wire is seen to make transverse vibrations. If the vibrating wire is observed in the dark, alternately luminous and obscure portions are seen. When the wire is attached to the positive pole of the machine the phenomenon takes the form of brilliant and equidistant lines, which are wider at the middle of the wire and thinner at the ends. In the case of the negative pole, a series of equidistant luminous points is seen all along the wire. The experiment was made with a glass tube eight feet long and 2.4 inches in diameter, and a wire gauging 0.1 inch. If two wires of the same length are stretched parallel and connected with the two poles of the machine (the outer ends being electrically free), the wires enter into vibration. In the dark, a series of equidistant luminous points are seen on the negative wire, while on the positive is a series of luminous lines whose centres correspond to the luminous points of the first wire. The experiment is very brilliant if the two wires are fused in the ends of a glass tube, and the luminous lines and points appear very regular. If the wires are close enough together, only one of them need be attached to the machine, the second being connected to earth, thus giving a condenser effect.

Electro-motive Force and Osmotic Pressure—Mr. R. A. Lehfeldt, of the East London Technical College, has a paper on the above subject in the last number of the Proceedings of the Physical Society. An expression is obtained for the electromotive force of a concentration cell, with or without migration, by means of a thermo-dynamic cycle; the expression, which is applicable to strong as well as weak solutions, is given first, on the assumption of Boyle's law, in terms of the degree of dissociation of the salt as found from the electrical conductivity; afterwards, without that assumption, in more general terms. According to this expression, the electro-motive force of a cell depends on the total osmotic pressure of the salt, not on that of the metallic ion only. Experiments are then described, both old ones recalculated, and new ones made for the occasion, in which the electro-motive force of concentration cells of $ZnCl_2$ and $ZnSO_4$ are measured; the results being recorded in curves and tables. Finally, from the data thus provided, the osmotic pressures of those salts in solutions nearly up to the point of saturation are calculated, and the analogy between those pressures and the pressures of highly compressed gases pointed out.

Electrolytic Injection—An interesting article on the electrolytic transmission of sulphur from the Harrogate sulphur waters through the pores of the skin has been contributed by Dr. F. W. Smith to the *Lancet.* He refers in this article to a previous communication in February last, in which he proved that nascent sulphur could be deposited on the skin of a patient in a bath of Harrogate sulphur water if a constant current of electricity were passed through it. He then dwelt on the good which could be done in cases of eczema, gout, rheumatism, etc., by this means, which effect a great improvement on the ordinary bathing. Since February he has made experiments to show that the nascent sulphur was actually taken through the patient' s skin and into circulation. In order to prove that this was so, experiments were made with a piece of pig's skin tied around the mouth of an open-mouthed vessel, the bottom of which had been previously knocked out. A piece of blotting paper was placed outside the skin external to the vessel, and the positive end of an anode was placed on the blotting paper. The vessel was then filled from the bottom with Harrogate sulphur water and the negative anode was put into it. Three milliamperes from a 13-cell battery (constant current) were turned on for half an hour. The result was that nascent sulphur was deposited on the pig's skin, driven right through it and on to the blotting paper at the positive pole. Illustrations are given in the article to show the sulphur deposit. The doctor also refers to a large number of cases in which good has been derived from the treatment.

Metric System in England—An international office of weights and measures is to be established in Sevres, France, by the decision of an international convention, which had for its object the establishment and verification and preservation of the international prototypes (models), and also the manufacture of copies of the prototypes for the use of nations represented in the convention. This office has been declared neutral, and shall be charged with the verification of the standard weights and measures for the benefit of scientific societies or persons interested in the matter. England was not willing at first to join the convention, but is now one of the foremost in it. The entire board of trade has received three standards: two metric and one kilogramme standard. The two standard metres are made of iridio-platinum; *i. e.,* an alloy of 90 per cent platinum and 10 per cent iridium. In cross-section the metres are like an X. This form has been selected not only because it is the most economical, but because it is the least affected by changes in temperature. Iridio-platinum has been given the preference over proposed materials, such as rock crystal, gold, etc., because of its natural durability, which is well adapted for the engraving of fine lines.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XLIII.

BY W. ELWELL GOLDSBOROUGH.

This modified diagram appeared in Fig. 108 in the middle position at the right. It is constructed from the data tabulated under Case VI, inasmuch as these data have been obtained from Case III by the application of the proper ratio. We therefore find that the electro-motive force finally impressed upon the parallel circuits is 303 volts, and the electro-motive force impressed upon the circuit A_3O 721 volts. The current which, under these conditions, flows in the branch circuit OA_1 is 14.3 amperes, and the current which flows in the branch circuit OA_2 is 16 amperes. Finally, the current flowing in the armature of alternator E^{III} when it is acting alone and generating 1,000 volts is 28.8 amperes.

In Fig. 108 we have all the data for the final solution of the problem. In accordance with the rule, it is now necessary to take the vector resultant of the partial currents flowing in each of the three lines, since these resultants will give the final current values. When E^I is acting alone the current $O'B_1^I$ flows in the circuit A_1O. When E^{II} is acting alone the current $O'B_1^{II}$ flows in A_1O, and when E^{III} is acting alone the current $O'B_1^{III}$ flows in A_1O. In getting the resultant of these three vectors we must take the vectorial sum of $O'B_1^{II}$ and $O'B_1^{III}$, and the vectorial difference of this sum and the vector $O'B_1^I$. In accomplishing this we lay off from B_1^{II} the vector $B_1^{II}B_1$ equal and parallel to $O'B_1^{III}$, then the distance $O'B_1$ is equal to the vectorial sum of $O'B_1^{II}$ and $O'B_1^{III}$. In taking the vectorial difference of $O'B_1$ and $O'B_1^I$ it is only necessary to measure the distance $B_1B_1^I$, which gives the final current flowing in the circuit OA_1 equal to 63.9 amperes.

In the same way the final current flowing in the circuit OA_2 is determined. In Fig. 108 the vectorial sum of $O'B_2^I$ and $O'B_2^{III}$ is first taken, giving the value $O'B_2$. The distance $B_2B_2^{II}$ is then equal to the final current flowing in the second circuit, equal to 50 amperes. The current flowing in the third circuit OA_3 is the resultant of the vectors $O'B_3^I$, $O'B_3^{II}$ and $O'B_3^{III}$. Taking the sum of $O'B_3^I$ and $O'B_3^{II}$ and the difference of their resultant and $O'B_3^{III}$, the final current in OA_3 equals $B_3B_3^{III}$, equals 41.2 amperes.

As the result of these determinations we find that the generator E^I develops the greatest electro-motive force and the largest current flows in its armature. The third alternator E^{III} develops the least electro-motive force, and, as might be expected, the least current I_3 equal to 41.2 amperes flows in its armature. In a general way, then, we find that the electro-motive forces are proportional to the currents which are developed in the armatures of their generators.

In determining the final values of the electro-motive forces impressed at the terminals of the three circuits, we have to take the resultants of the three electro-motive forces which the generators, acting separately, impress upon the individual circuits. For instance, when E^I is acting alone it impresses an electro-motive force $A_1^IA^I$ upon OA_1, when E^{II} is acting alone it impresses an electro-motive force $O'A_2^{II}$ upon the circuit OA_1, and when E^{III} is acting alone it impresses an electro-motive force $O'A_3^{III}$ upon the circuit OA_1. The final electro-motive force acting at the terminals of the circuit OA_1 will be the resultant of these partial electro-motive forces and must be determined by taking the vectorial sum of $O'A_2^{II}$ and

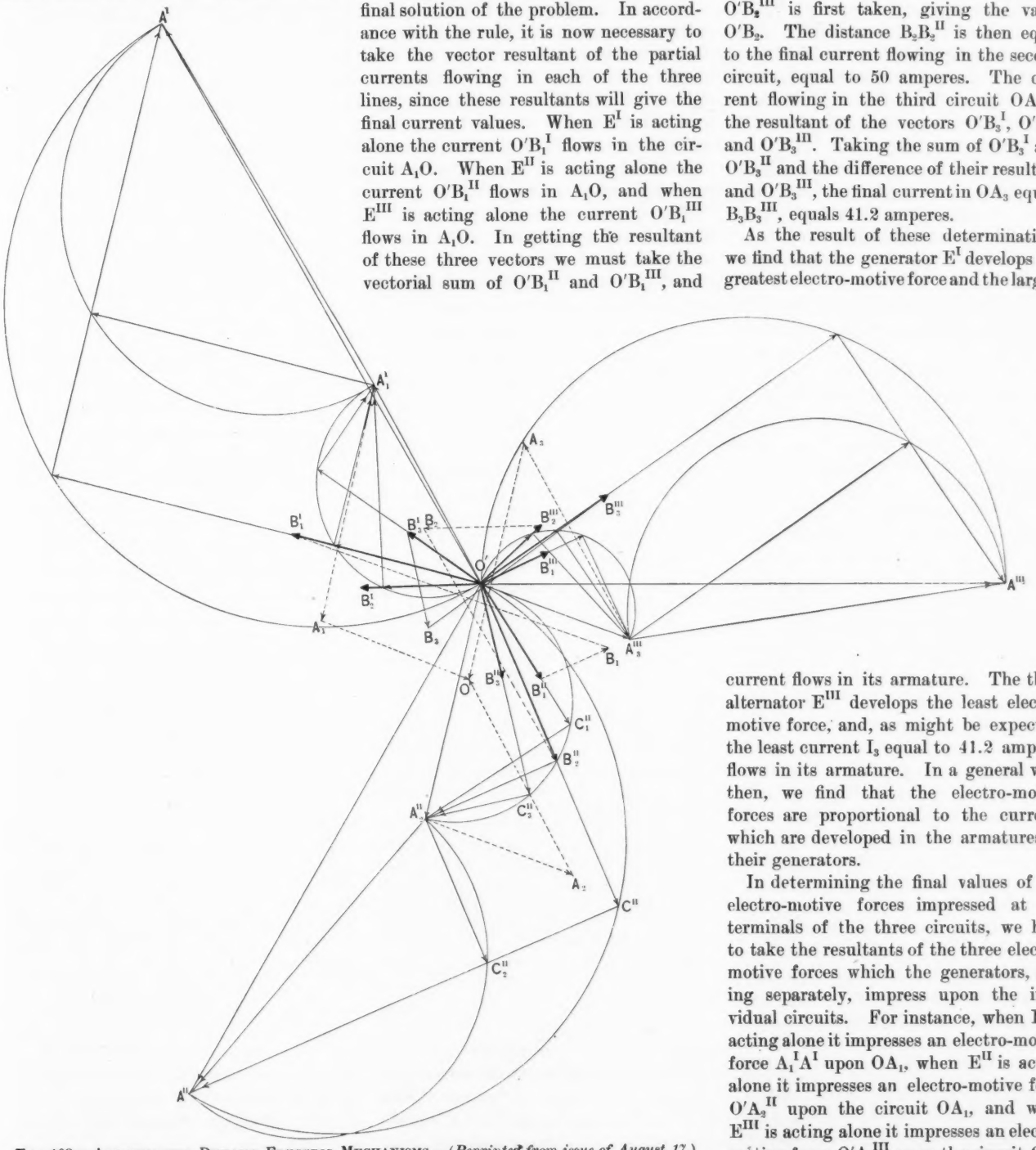


FIG. 108.—ALTERNATING DYNAMO ELECTRIC MECHANISMS.—(*Reprinted from issue of August 17.*)

$O'A_3^{III}$, and the difference of this sum and the vector $A_1^{I}A^{I}$. In accomplishing this result graphically we lay off from the point A_1^{I}, the vector $A_1^{I}A_1$ equal and parallel to $O'A_2^{II}$, and the vector A_1O equal and parallel to $O'A_3^{III}$. The distance OA^{I}, equal to 1,349 volts, is finally determined as the value of the electro-motive force impressed on the first circuit.

In the same way, when E^{I} is acting alone, an electro-motive force $O'A_1^{I}$ is impressed upon the circuit OA_2, when E^{II} is acting alone, an electro-motive force $A_2^{II}A^{II}$ is impressed upon the circuit OA_2, and when E^{III} is acting alone an electro-motive force $O'A_3^{III}$ is impressed upon the circuit OA_2. The resultant of these vectorial values is determined by laying off from A_2^{II} the vector $A_2^{II}A_2$ equal and parallel to $O'A_3^{III}$, and from A_2 the vector A_2O equal and parallel to $O'A_1^{I}$. The final vector distance, which represents the electro-motive force impressed on the circuit OA_2, is the vector distance OA^{II} equal to 939 volts.

The final electro-motive force appearing at the terminals of the third circuit must, in the same manner, be found by taking the resultant of the partial electro-tro-motive forces $A_3^{III}A^{III}$, $O'A_2^{II}$ and $O'A_1^{I}$. This resultant is equal to the vector distance OA^{III}, equal to 1,134 volts.

The final values of the currents and the line electro-motive forces are tabulated under Case VII. By the data determined, it is seen that the electro-motive force appearing at the terminals of the line OA_1 is 149 volts greater than the electro-motive force E^{I} acting in this circuit. The electro-motive force appearing at the terminals of the circuit OA_3 is also greater than the electro-motive force developed by the generator acting in this circuit; but the electro-motive force at the terminals of the second circuit OA_2 is less by 161 volts than the electro-motive force which alternator E^{II} generates.

If we scale Fig. 108 to determine the phase angles between the electro-motive forces and currents we find that the current I_1 in the first circuit lags 38 degrees behind the electro-motive force developed by alternator E^{I}, and 45 degrees behind the electro-motive force apparent at the terminals of the circuit OA_1. In the case of the second circuit we find that the current I_2 lags 57 degrees behind the electro-motive force developed by generator E^{II} and 63 degrees behind the electro-motive force apparent at the terminals OA_2, while in the third circuit the current I_3 lags 34 degrees behind the generator electro-motive force E^{III}, but only 27 degrees behind the electro-motive force appearing at the terminals OA_3 of Fig. 104.

DATA PERTAINING TO EXAMPLE 21.

Case I.—Circuit No. I in series with circuits Nos. II and III in parallel. Generator E^{I} running.

$E_1^{I} = 474$ volts	$E_1r^{I} = 335$ volts	$E_1x^{I} = 335$ volts	$I_1^{I} = 22.2$ amperes
$E_2^{I} = 250$ "	$E_2r^{I} = 113$ "	$E_2x^{I} = 224$ "	$I_2^{I} = 13.5$ "
$E_3^{I} = 250$ "	$E_3r^{I} = 224$ "	$E_3x^{I} = 113$ "	$I_3^{I} = 9.9$ "

and $E^{I} = 722$ volts.

Case II.—Circuit No. II in series with circuits Nos. I and III in parallel. Generator E^{II} running.

$E_1^{II} = 250$ volts	$E_1r^{II} = 175$ volts	$E_1x^{II} = 175$ volts	$I_1^{II} = 11.8$ amperes
$E_2^{II} = 376$ "	$E_2r^{II} = 168$ "	$E_2x^{II} = 338$ "	$I_2^{II} = 20.4$ "
$E_3^{II} = 250$ "	$E_3r^{II} = 226$ "	$E_3x^{II} = 111$ "	$I_3^{II} = 10.0$ "

and $E^{II} = 610$ volts.

Case III.—Circuit No. III in series with circuits Nos. I and II in parallel. Generator E^{III} running.

$E_1^{III} = 250$ volts	$E_1r^{III} = 179$ volts	$E_1x^{III} = 179$ volts	$I_1^{III} = 11.8$ amperes
$E_2^{III} = 250$ "	$E_2r^{III} = 110$ "	$E_2x^{III} = 220$ "	$I_2^{III} = 13.2$ "
$E_3^{III} = 596$ "	$E_3r^{III} = 534$ "	$E_3x^{III} = 266$ "	$I_3^{III} = 23.8$ "

and $E^{III} = 825$ volts.

Case IV.—Circuit No. I in series with circuits Nos. II and III in parallel. Generator E^{I} developing 1,200 volts.

$E_1^{I} = 788$ volts	$E_1r^{I} = 557$ volts	$E_1x^{I} = 557$ volts	$I_1^{I} = 37.0$ amperes
$E_2^{I} = 416$ "	$E_2r^{I} = 187$ "	$E_2x^{I} = 372$ "	$I_2^{I} = 22.4$ "
$E_3^{I} = 416$ "	$E_3r^{I} = 372$ "	$E_3x^{I} = 187$ "	$I_3^{I} = 16.5$ "

Case V.—Circuit No. II in series with circuits Nos. I and III in parallel. Generator E^{II} developing 1,100 volts.

$E_1^{II} = 450$ volts	$E_1r^{II} = 316$ volts	$E_1x^{II} = 316$ volts	$I_1^{II} = 21.2$ amperes
$E_2^{II} = 679$ "	$E_2r^{II} = 302$ "	$E_2x^{II} = 607$ "	$I_2^{II} = 36.6$ "
$E_3^{II} = 450$ "	$E_3r^{II} = 407$ "	$E_3x^{II} = 201$ "	$I_3^{II} = 18.0$ "

Case VI.—Circuit No. III in series with circuits Nos. I and II in parallel. Generator E^{III} developing 1,000 volts.

$E_1^{III} = 303$ volts	$E_1r^{III} = 216$ volts	$E_1x^{III} = 216$ volts	$I_1^{III} = 14.3$ amperes
$E_2^{III} = 303$ "	$E_2r^{III} = 133$ "	$E_2x^{III} = 267$ "	$I_2^{III} = 16.0$ "
$E_3^{III} = 721$ "	$E_3r^{III} = 646$ "	$E_3x^{III} = 322$ "	$I_3^{III} = 28.8$ "

Case VII.—Generators E^{I}, E^{II} and E^{III} running synchronously. Generator E^{I} developing 1,200 volts, generator E^{II} 1,100, and generator E^{III} 1,000 volts.

$E_1 = 1{,}349$	$I_1 = 63.9$	$\phi^{I} = 38°$	$\phi_1 = 45°$
$E_2 = 939$	$I_2 = 50.0$	$\phi^{II} = 57°$	$\phi_2 = 63°$
$E_3 = 1{,}134$	$I_3 = 41.2$	$\phi^{III} = 34°$	$\phi_3 = 27°$

In the first and second circuits the lag of the currents behind the impressed electro-motive forces is greater than the lag of the currents behind the generator electro-motive forces, while in the third circuit, the reverse condition exists.

In determining the power developed by the generators and absorbed in the several circuits, we have only to apply Equation 91 on page 659, of vol. xxxvii, and substitute therein the proper current, electro-motive force and cosine values. By such a calculation we find

The power developed by alternator E^{I} equals $1{,}200 \times 63.9 \times .788 = 60{,}000$ watts.
" " " " " E^{II} " $1{,}100 \times 50.0 \times .542 = 29{,}800$ "
" " " " " E^{III} " $1{,}000 \times 41.2 \times .825 = 33{,}900$ "

Total equals ..... 123,700 watts.

The power absorbed in the circuit OA_1 equals $1{,}349 \times 63.9 \times .707 = 61{,}000$ watts.
" " " " " OA_2 " $939 \times 50.0 \times .447 = 20{,}900$ "
" " " " " OA_3 " $1{,}134 \times 41.2 \times .894 = 41{,}800$ "

Total equals ..... 123,700 watts.

It is necessary in any alternating-current distributing system that measurements made of the power absorbed should equal the measured developed power. In the present case this condition is found to be fulfilled. The developed power is equal to 123,700 watts, and the absorbed power is equal to the same amount. We find, however, that the power is not distributed between the three systems in proportion to the power developed by the three generators. The first and third circuits absorb more than a proportional part of the developed power, whereas the second circuit absorbs less than a proportional part of the developed power. This lack of proportionality in the distribution of developed power between the three circuits is due to the fact that the system, as a whole, is an unbalanced one, and, therefore, to some extent, the power developed by the second generator is absorbed in circuits other than its own.

Selected Chapters in Electrochemistry.

By Harry C. Jones.

CHAPTER VI—CONDUCTIVITY OF SOLUTIONS.

PART II.

THE DISSOCIATING POWER OF DIFFERENT SOLVENTS.*

We have dealt thus far in these papers exclusively with aqueous solutions, and the conclusion might be drawn that the theory of electrolytic dissociation applies only to solutions in water as the solvent. We shall now learn that such is by no means the case, since there are many solvents which have a marked dissociating power.

Water, to be sure, is the strongest dissociant known, breaking down electrolytes into ions to a greater extent than any other known substance, but there are other solvents which do not stand very far behind water in this respect. We shall take up first some inorganic solvents, then some organic solvents, and, finally, some mixtures of different solvents.

Liquid ammonia has been shown, especially by the work of Franklin and Kraus, to have a very considerable power as an ionizing solvent. Indeed, the molecular conductivities of certain electrolytes in liquid ammonia are greater than in water at the same concentration. This alone would not show that there is greater dissociation in the liquid ammonia than in water, since the measurements were made in the ammonia at its boiling point—38 degrees—while the measurements were made in water at 18 degrees, or 82 degrees below its boiling point. In order that the two sets of results should be comparable the molecular conductivities in water at its boiling point should be compared with those in liquid ammonia at its boiling point. Further, if the molecular conductivities in liquid ammonia should even prove to be greater, under comparable conditions, than in water, this alone would not show that ammonia has the greater dissociating power, since the dissociation α, is the ratio between μ_v and μ_∞, and μ_v might be larger in ammonia than in water, and μ_∞ still larger in the ammonia. In this case α would be smaller in the ammonia. Such is, indeed, the fact; the greater molecular conductivity in the liquid ammonia being due rather to the great velocity with which the ions move through this solvent, than to the large number of ions present.

Nitric acid, in the liquid state, has been shown to have very great ionizing power. Indeed, from the few results thus far obtained it seems to have nearly as great dissociating power as water itself, but the data thus far available with this solvent are far too meagre to justify any final conclusion.

Sulphur dioxide, in the liquid condition, has been found by Walden to have a considerable dissociating power. Comparing the molecular conductivities of a number of salts in sulphur dioxide, with the results for the same salts in water at 0 degrees, Walden concluded that liquid sulphur dioxide dissociates to from one-fourth to one-half the extent of water.

Of the organic solvents whose dissociating power is known, *formic acid* stands at the head of the list. Quite an elaborate investigation on the dissociating power of formic acid was carried out by Zanninovich-Tessarin. He used chiefly the freezing point method, but determined also the conductivity of a few salts in this solvent. He concluded that formic acid is one of the strongest dissociating solvents next to water. The behavior of hydrochloric acid in this solvent is most remarkable. Although it is one of the most strongly dissociated substances in water, it shows no dissociation whatever, in formic acid, as measured by the freezing-point method. Indeed, in the latter solvent it is actually polymerized, according to the results obtained by this method. On the other hand, hydrochloric acid shows very marked conductivity in this solvent, indicating dissociation. This apparent discrepancy may be due to the fact that while most of the molecules are polymerized into large complexes, some are dissociated into ions, which conduct the current.

Methyl alcohol, among the organic solvents, stands next to formic acid in its power to break down molecules into ions. A large number of investigators have worked on the conductivity of solutions of electrolytes in this solvent, but, on the whole, perhaps the work of Zelinsky and Krapiwin deserves special mention. Their work included a number of salts in pure methyl alcohol, as well as in a mixture of methyl alcohol and water. If the molecular conductivities in the methyl alcohol are compared with those in water at the same dilution, we would see that they are not very different. The conductivity in methyl alcohol is from two-thirds to three-fourths that in water, under the same conditions.

An examination of the conductivity results in methyl alcohol will show that it is almost impossible to reach the values of μ_∞ for the most strongly dissociated substances in this solvent. The dilution at which the electrolyte would be completely dissociated by this solvent is so great that it is nearly impossible to apply the conductivity method to it with even a fair degree of accuracy. It is, therefore, not possible to measure dissociation accurately in this solvent by means of the conductivity method. The same remarks apply with even greater force to those solvents whose dissociating power is less than that of methyl alcohol. In such cases it is impossible to obtain the values of μ_∞ by the conductivity method, and, hence, the dissociation values obtained by this method can only be regarded as rough approximations. They are obtained by assuming that the values of μ_∞ in the solvent in question are the same as in water. An assumption which we know is not correct, since the friction offered by the different solvents to the movements of the ions is different, the velocities of the ions through these solvents would, therefore, be different, and the values of μ_∞ must be different. The above assumption is, however, the best that can be done under the conditions.

Another method of measuring dissociation has been applied by Jones to solvents like methyl alcohol. Attention has already been called to the lowering of the vapor-tension of solvents by dissolved substances. But lowering of vapor-tension is proportional to rise in boiling-point, and if we measure the rise in the boiling-points of solvents produced by dissolved substances, we can calculate the dissociation of the dissolved substances in exactly the same way as we calculated the dissociation of dissolved substances from the lowering of the freezing-point of the solvent produced by them. Very satisfactory results were obtained by the boiling-point method for the dissociation of a number of salts in methyl alcohol, and the final conclusion was reached, as the result of this work, that the dissociation in methyl al-

*This paragraph is taken from a review of the Dissociating Power of Solvents, recently prepared by H C. Jones, and published in the *American Chemical Journal*, xxv, 232.

cohol is, in round numbers, about two-thirds of that in water under the same conditions.

Ethyl alcohol has a much smaller dissociating power than methyl alcohol, as indicated by the conductivity method; but the dissociating power of this solvent can be measured only with very rough approximation by the conductivity method, on account of the impossibility of determining μ_∞.

The dissociation of a number of salts in ethyl alcohol has been measured by Jones, using the boiling-point method as with methyl alcohol. The results showed that the dissociating power of ethyl alcohol is from one-third to one-fourth that of water at the same dilution of the solutions.

The *more complex alcohols* dissociate much less than the simpler members of the series, as is indicated from the conductivity results, but for all slightly dissociating solvents the conductivity measurements must be taken as only very rough approximations, as a measure of dissociation. It has been found to be a general rule that *in a homologous series of compounds the lower members have much higher ionizing power than the more complex members of the series.*

The conductivities of a number of electrolytes in *acetone and other ketones* have been measured, especially by Cattaneo, Carrara and St. v. Laszczynski. Such solutions have considerable conductivity, showing a marked ionization in these solvents. The ionizing power of the ketones in general decreases with increase in the complexity of the molecule.

The ionizing power of the *nitriles* has also been found to decrease with the complexity of the molecule.

The dissociating power of a number of other organic solvents has been studied. Solutions in ether, glycerine, chloroform, the hydrocarbons, and similar compounds, conduct very poorly. Some very surprising results have been obtained in *mixed solvents,* one example of which will be referred to. While electrolytes in methyl alcohol conduct the current very well, the conductivity is considerably less than in water. Zelinsky and Krapiwin found that certain salts have a greater conductivity in a pure methyl alcohol than in a mixture of 50 per cent methyl alcohol and 50 per cent water. This is shown by the following results:

V is the volume of the solution, or the number of litres which contain a gram-molecular weight of the dissolved substance. and μ_v the molecular conductivity at volume v.

POTASSIUM BROMIDE.

	Water.	Methyl Alcohol.	One-half Methyl Alcohol, One-half Water.
v	μv	μv	μv
16	123.1	....	59.82
64	130.5	76.70	65.36
256	136.4	88.96	69.26
512	140.2	93.26	70.53

AMMONIUM IODIDE.

	Water.	Methyl Alcohol.	One-half Methyl Alcohol, One-half Water.
v	μv	μv	μv
16	125.4	72.24	62.63
64	133.4	85.00	67.48
256	138.7	96.20	70.34
1024	143.7	104.70	71.57

It is impossible at present to say what these surprising and remarkable results mean. They have been confirmed by the work of others.

Similar results have been obtained by Cohen with mixtures of ethyl alcohol and water, but only when the mixture contained very little water, and when the dilution of the solution was quite great.

RELATIONS BETWEEN THE IONIZING POWER OF SOLVENTS AND OTHER PROPERTIES.

A number of attempts have been made to discover relations between the ionizing power and other properties of solvents. J. J. Thomson first proposed the theory, and a little later Nernst suggested the same idea, that there should be a close relation between the dissociating powers of solvents and their dielectric constants or specific inductive capacities. Those solvents which have the greatest dielectric constants undoubtedly have the greatest dissociating powers. With the possible exception of hydrogen dioxide, about which there is some doubt, water has the highest dielectric constant, and also has the greatest dissociating power. Next to water comes formic acid, both with respect to dielectric constant and dissociating power. Of the more common organic solvents methyl alcohol has the highest dielectric constant and also the greatest ionizing power. Ethyl alcohol has a considerably smaller dielectric constant and, as we have seen, much less power to break down molecules into ions.

Another suggestion, which we owe to Dutoit and Aston, is that the ionizing power of a solvent is closely connected with the state of aggregation of its own molecules; the greater the complexity of the molecules of any solvent the greater its power to break down molecules of dissolved substances into ions. We have a method of determining the complexity of molecules of liquids based upon the measurement of their surface tensions. This method was devised and applied to a number of liquids by Ramsay and Shields some 10 years ago, with the result that many of the common solvents were found to consist of complex molecules. Thus, the molecules of the alcohols were, in general, made up of more than one of the simplest molecules, and water was found to be the most complex of all the liquids known. Its molecule consisted of four of the simplest water molecules—$(H_2O)_4$. This most associated of all known liquids has the strongest ionizing power.

While there is undoubtedly an element of truth in both of these suggestions, they are far from an expression of the whole truth. These relations fail to hold, especially among the weakly dissociating solvents, where it is often impossible to say, either from the dielectric constants or from the degree of association, which of two solvents has the greater dissociating power. It will probably be shown that the dissociating power of a solvent is not a function of any one physical or chemical property of the substance, but of them all. Or, perhaps, more accurately expressed, all the properties of a substance are a function of the energy relations which obtain in that substance, and dissociating power is simply one of these properties. The conclusion from the study of the ionizing power of solvents, which is of greatest importance, is that ions are probably always present when chemical reaction takes place. When the number of solvents which can effect ionization is taken into account, and, further, that heat and possibly pressure can break molecules down into their ions, it will be seen that there is not a chemical reaction where the conditions for ion formation do not exist.

RELATION BETWEEN THE DILUTION OF SOLUTIONS AND THEIR DISSOCIATION.

It has already been pointed out that the percentage dissociation of solutions increases with the dilution, but while our knowledge was in this purely qualitative stage we could scarcely hope to deduce any consequences of importance from it. A quantitative relation between dilution and dissociation has, however, been worked out by Ostwald, and has led to such important consequences that it must be carefully considered.

Ostwald* was impressed by the relation between an electrolyte undergoing dissociation into ions in the presence of a solvent like water, and a substance like ammonium chloride undergoing dissociation into the molecules, ammonia and hydrochloric acid, by heat. Since the laws

* *Ztschr. phys. Chem.*, ii, 136-276; iii. 170. See also Theory of Electrolytic Dissociation, p. 143.

of gas-pressure apply to the osmotic pressure of solutions, it seems probable that any deductions for the dissociation of a vapor by heat would apply to the dissociation of an electrolyte by a solvent like water. Starting with this idea in mind Ostwald developed the following relations.

Given a vapor which is undergoing dissociation by heat, say that of ammonium chloride. If neither of the products of dissociation is present in excess, and if the temperature is maintained constant, the following relation obtains:

$$\frac{p}{p_1^2} = \text{constant}, \qquad (1)$$

in which p is the pressure of the original gas, and p_1 that of the decomposition products. Turning now to solutions, we must deal with osmotic pressure instead of gas-pressure. The osmotic pressure is proportional to the amount of substance present, and inversely proportional to the volume. Let u be the mass of the undecomposed electrolyte, and u_1 the mass of the decomposition products; v is the volume:

$$p = \frac{u}{v} \text{ and } p_1 = \frac{u_1}{v}.$$

Substituting these values in (1), we have:

$$\frac{uv}{u_1^2} = \text{constant}. \qquad (2)$$

The amount of the dissociation products u_1, is equal to the relation between the conductivity at volume v (μ_v), and the conductivity at infinite dilution (μ_∞):

$$u_1 = \frac{\mu_v}{\mu_\infty}.$$

The amount of the undissociated substance u, is the complement of u_1:

$$u = 1 - \frac{\mu_v}{\mu_\infty}.$$

Substituting these values of u and u_1 in (2) we have:

$$\frac{\mu_\infty (\mu_\infty - \mu_v)}{\mu_v^2} v = \text{constant}, \qquad (3)$$

and this is the dilution law of Ostwald. This can, however, be simplified. If we represent the activity coefficient, or the amount of dissociation, by a:

$$a = \frac{\mu_v}{\mu_\infty}.$$

Substituting this value in (3) we have:

$$\frac{a^2}{(1-a)\,v} = \text{constant}. \qquad (4)"$$

So much for the mathematical deduction of the relation between these two kinds of dissociation. It now remains to see whether the deduction is correct, whether the conclusion is in accord with the facts. The way to test this is to take a solution of an electrolyte and determine its dissociation by the conductivity or freezing-point method; knowing the volume v, or the concentration of the solution, and having determined the dissociation a, we substitute these values in the above equation and calculate the value of the constant. We now dilute the solution still farther and determine the value of a for the new dilution. Knowing v for the new dilution and having determined a, we substitute these values in the above equation and calculate anew the value of the constant for this dilution. We proceed in exactly the same manner for a wide range of dilutions, and then see whether the values obtained for the constant are really constant or not, over a range of dilutions. Some of the results obtained for a few substances are given below:

ACETIC ACID.

v	a	Constant.
8	1.193	0.00180
32	2.38	0.00182
256	6.56	0.00180
1024	12.66	0.00177

BUTYRIC ACID.

v	a	Constant.
8	1.068	0.00144
32	2.165	0.00149
256	5.988	0.00149
1024	11.41	0.00144

AMMONIA.

v	a	Constant.
8	1.35	0.0023
32	2 65	0.0023
128	5.33	0.0023
256	7.54	0.0024

TRIPHENYLMETHANE.

v	Constant.
8	0.0069
32	0.0075
64	0 0076
256	0.0074

The Ostwald dilution law deduced above, seems to hold fairly well for the above substances. Ostwald applied the law to more than two hundred organic acids, and Bredig applied it to a large number of organic bases; and it held satisfactorily for nearly all of these substances. The conclusion might be drawn from these facts that the law was of universal application, but it should be observed that the above compounds, organic acids and organic bases, are all weakly dissociated substances, as compared with inorganic substances. It might be that the law would hold for the weakly dissociated compounds, and not hold for the strongly dissociated acids, bases, and salts. This has, indeed, been found to be the case. The law of Ostwald does not hold for a single strongly dissociated substance.

The question is what is to be done? We have a dilution law for the weakly dissociated compounds, but we can not discard the strongly dissociated compounds—the most important substance, by far, from a chemical standpoint. Fortunately, this is not necessary since the following discovery was made.

"Rudolphi,* from a study of the conductivity of solutions of silver nitrate of varying concentrations, discovered a new relation which obtains for the strongly dissociated compounds. If we represent the volume by v and the constant by c, as above, he found that when he applied the Ostwald equation to solutions of silver nitrate, he obtained the following values:

For $v = 16$, $c = 0.26$.
For $v = 64$, $c = 0.13$.
For $v = 256$, $c = 0.065$.

A glance at these figures will show that a real constant would be obtained, if the values of c were multiplied by the square root of v in each case; thus:

$$0.26 \times \sqrt{16} = 0.13 \times \sqrt{64} = 0.065 \times \sqrt{256}.$$

We must then substitute for v, in the Ostwald expression, the square root of v when it becomes:

$$\frac{a^2}{(1-a)\sqrt{v}} = \text{constant}.$$

Rudolphi applied his equation to between fifty and sixty strongly dissociated compounds, and the values found for c approached a constant. While marked deviations are not wanting, yet Rudolphi's expression applies as well to the strongly dissociated electrolytes, as that of Ostwald to those which are less strongly dissociated, as the organic acids and bases. This will be seen from the following examples:

Hyd ochloric Acid.		Potassium Sulphite.		Potassium Acetate.	
v	c	v	c	v	c
2	4.36	2	0.453	2	1.24
4	4 45	8	0.454	100	1.19
8	5.13	32	0.455	1,000	1.18
16	5.13	128	0.544	10,000	1.03

The Rudolphi expression is, of course, purely empirical. The physical significance of the $\sqrt{v}$ is thus far entirely unexplained. One or two modifications of the Rudolphi formula have been proposed, but these are also empirical, and can not be regarded as essentially in advance of the original."

We have, then, one dilution holding for the weakly dissociated electrolytes and another applying to the strongly dissociated compounds. The dilution law of Ostwald, which applies to the weakly dissociated compounds, has a rational basis, as we have seen; being deduced from an equation for a dissociating vapor, which

*This paragraph is quoted from Theory of Electrolytic Dissociation. (Macmillans), pp. 144-145.

*Ztschr. phys. Chem., xvii. 385. The above paragraph is quoted from Theory of Electrolytic Dissociation, pp. 147-148.

was established not only empirically by direct experiment, but which has also been deduced thermodynamically. The physical significance of this law is perfectly apparent, but not so with the dilution law of Rudolphi, which applies to the strongly dissociated compounds. It has been established only by experiment, and is, therefore, purely empirical. Its relations to other things are not known, and we have no idea what is the physical significance of the square root of v in this expression. It, however, seems to fit the facts in the cases of strongly dissociated substances, and we may some day learn its significance.

These dilution laws are not simply wide-reaching generalizations, which embrace a large number of facts; as important as such generalizations always are; but they have a special significance. The numerical values of the constants for different substances give us a world of information about these compounds. The *chemical activities of compounds are proportional to these constants.* The full significance of this relation may not appear at first sight. Its importance will become apparent from the following considerations. By the chemical activity of a substance we mean its power to enter into chemical combinations with other substances, how it will behave in presence of other compounds, what reactions it will effect and the velocities with which such reactions will take place; in a word, the entire chemical nature and conduct of a substance. All this is given at once by the value of the "Dissociation constant" of the substance, obtained from the dilution laws which we have just been considering. From such facts we can see the real significance and importance of the dilution laws, as expressing the relation between the dilution of the solution and the dissociation of the dissolved substance.

THE IONIZING POWER OF HEAT.

We have dealt thus far with electrolytic dissociation as taking place only in solutions of certain substances in certain solvents. A question which has thus far been unanswered is, what effect does rise in temperature have on the amount of the electrolyte which is dissociated? This question is made all the more prominent by the well-known fact that heat dissociates the vapors of many compounds like ammonium chloride, phosphorus pentachloride, etc.; and we have just pointed out a relation (Ostwald dilution law) between this dissociation into molecules by heat and electrolytic dissociation into ions by solvents like water.

An investigation on the effect of temperature on electrolytic dissociation in aqueous solutions has been carried out by Douglas and myself* during the past year, and the result has been to show that between 0 degree and 35 degrees—the limits of the investigation—temperature has little or no effect on dissociation in solution.

We might conclude from the above fact that heat has no power to break molecules down into ions, but such a conclusion would not be justified. We must first study the effect of heat alone, when there is no solvent present. To do this we must heat the dry compound, perhaps, to its fusion point, to see whether in fused electrolytes there is any evidence of the presence of ions. The result can be stated in a word. Many electrolytes, when fused, conduct the current to a very considerable extent. Some of the compounds thus far studied are sodium, and calcium chlorides, potassium bromide and iodide, pottasium, ammonium, and silver nitrates, etc. The evidence is perfectly clear that heat, as well as solvents, can ionize molecules; *i. e.,* can effect electrolytic dissociation.

WAYS IN WHICH IONS ARE FORMED.

This rather long chapter will be concluded with some account of the different ways in which ions are formed from molecules. The conclusion to which one would be led at first, from a general study of the whole subject, is that ions are formed from molecules in only one way—a *molecule, under certain conditions, breaking down into an equivalent number of cations and anions.* While this is the method most frequently followed in electrolytic dissociation, it is by no means the only method. That this method may be more clearly understood, and for the sake of comparison with other methods, a few examples of dissociation by this method are given:

$$HCl = \overset{+}{H} + \overset{-}{Cl} \qquad NaOH = \overset{+}{Na} + \overset{-}{OH}$$

$$HNO_3 = \overset{+}{H} + \overset{-}{NO_3} \qquad NH_4OH = \overset{+}{NH_4} + \overset{-}{OH}$$

$$\begin{cases} H_2SO_4 = \overset{+}{H} + \overset{-}{HSO_4} \\ \overset{-}{HSO_4} = \overset{+}{H} + \overset{=}{SO_4} \end{cases} \qquad Ba(OH)_2 = \overset{++}{Ba} + \overset{-}{OH} + \overset{-}{OH}$$

$$KCl = \overset{+}{K} + \overset{-}{Cl}$$

$$K_2SO_4 = \overset{+}{K} + \overset{+}{K} + \overset{=}{SO_4}$$

$$BaCl_2 = \overset{++}{Ba} + \overset{-}{Cl} + \overset{-}{Cl}$$

$$CuSO_4 = \overset{++}{Cu} + \overset{=}{SO_4}$$

These examples, of acids, bases, and salts, suffice to illustrate the principle, which is exemplified whenever these compounds dissolve in a strongly dissociating solvent like water.

*Results will soon appear in *American Chemical Journal.*

Another entirely different method of ion formation is exemplified when *an atom takes a charge from an ion, becoming itself an ion, the original ion becoming an atom.* This takes place when a metal like zinc is brought in contact with a solution of a salt of another metal like copper. The copper which is in the ionic state gives up its charge to the zinc, becoming itself an atom, while the zinc atom, having taken the charge from the copper, becomes an ion. This mode of ion formation would be expressed thus:

$$\overset{++}{Cu} + \overset{=}{SO_4} + Zn = \overset{++}{Zn} + \overset{=}{SO_4} + Cu.$$

There is no change whatever in the anion. It remains in the solution after the reaction, in exactly the same condition as before. The copper ion gives up its charge to the zinc and is precipitated as metallic copper. This mode of ion formation explains all those chemical reactions in which one metal precipitates another metal from its salts. All that takes place in such reactions is the transfer of the electrical charge from the metal which is precipitated to the metal which passes into solution in the ionic state.

A third mode of ion formation differs fundamentally from the two modes just considered: *One substance passes from the atom into a cation, another substance at the same time passing from the atom into the corresponding anion.* The example of this mode of ion formation which is usually cited, is the solution of gold in chlorine water. Metallic gold in the presence of water does not form ions to any appreciable extent, and chlorine in the presence of water does not form ions to any appreciable extent. If metallic gold and ordinary chlorine are brought into the presence of water simultaneously, the gold passes over into the cationic condition and the chlorine forms an equivalent number of anions, in the sense of the following equation:

$$Au + Cl + Cl + Cl = \overset{+++}{Au} + \overset{-}{Cl} + \overset{-}{Cl} + \overset{-}{Cl}.$$

We have thus an insight into the mechanism of what takes place in a reaction which was hitherto simply described as the "solution of gold in chlorine water," which was, of course, simply renaming the phenomena. This is another of the many examples of the way in which the theory of electrolytic dissociation has thrown light on chemical problems. We may look upon the reaction thus: The neutral gold takes positive electricity from the neutral chlorine, becoming positively charged, while the chlorine having lost positive electricity is no longer elec-

trically neutral, but becomes negatively charged.

The fourth and last mode of ion formation is in a certain sense the most important, in that it deals with many of the phenomena in chemistry which are referred to as oxidation and reduction. *An ion takes on an additional charge of electricity, converting an atom into an ion with the opposite charge.* This is very simply illustrated by the case of ferrous chloride and chlorine. Ferrous chloride in the presence of chlorine becomes ferric chloride, in the sense of the following equation:

$$\overset{++}{Fe} + \bar{Cl} + \bar{Cl} + Cl = \overset{+++}{Fe} + \bar{Cl} + \bar{Cl} + \bar{Cl}.$$

The ferrous ion with its two charges takes up a third charge and becomes a ferric ion; at the same time converting a chlorine atom into a chlorine ion. This will be recognized at once as an example of what in chemistry is known as oxidation. The terms oxidation and reduction in chemistry are used in two senses. They mean the addition of oxygen or the addition of hydrogen. They are also used in an entirely different sense, as meaning the increase or decrease of the valence of a substance, and since we now deal with valence in terms of Faraday's law, and mean by it the number of charges upon the ions, oxidation means simply the increase in the number of charges upon the ion, and reduction a decrease in this number.

Using oxidation in this latter sense we see that the above mode of ion formation is an example of it; ferrous iron with two positive charges passing into ferric iron with three positive charges. Reduction is, of course, exactly the reverse process; *i. e.*, the removal of some of the charges already present upon the ion.

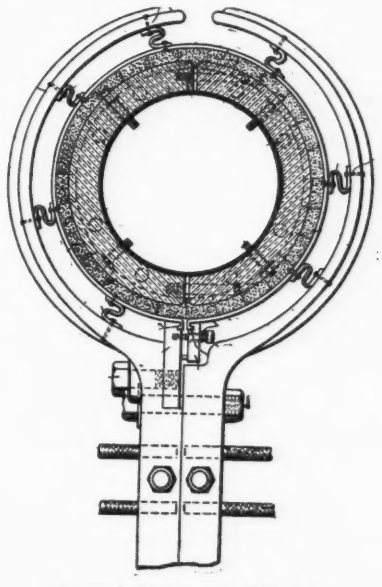
We have, then, in this mode of ion formation a physical explanation of what takes place in oxidation and reduction reactions, when these terms are used in the second of the two senses referred to above.

The above four include all the modes by which ions are formed from molecules. If we study them carefully in their bearing on chemical reactions in general, we shall see that they furnish a physical basis for a large number of reactions, whose meaning was hitherto entirely concealed.

In the light of what has thus far been brought out in these papers, we should begin to see the importance of the theory of electrolytic dissociation as applied to chemical phenomena. In the following chapter the bearing of this and other generalizations on a strictly electrochemical problem will be pointed out.

Electrical Patents

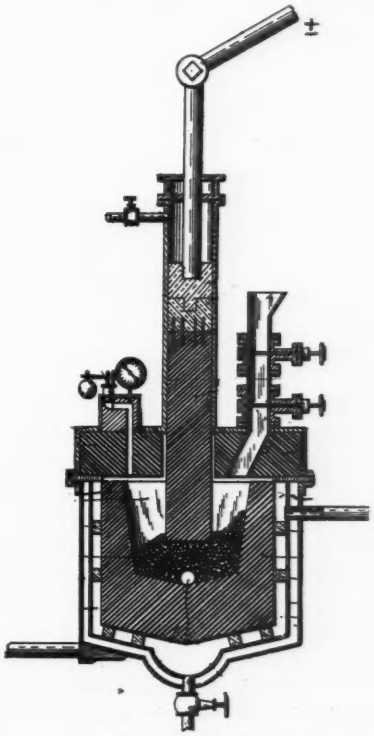
Another patent which has been purchased by the General Electric Company, covers a current-collecting device designed especially for conveying heavy currents to shafts or similar large bodies having a slow speed of rotation in pro-



CURRENT-COLLECTING DEVICE.

portion to the amount of current to be transmitted. In collectors of this kind, much trouble has been experienced in providing sufficient contact surface for applying the brushes of the collector-rings thereto with a sufficient degree of pressure. The inventor, who is Mr. Walter S. Moody, of Schenectady, N. Y., claims that the present apparatus overcomes all of these difficulties. It is constructed substantially as follows: The collector-ring support, made of two semi-circular segments, is secured to the shaft or body, suitable insulating material, however, being arranged between the same. The collector-ring is fastened to this support, and comprises a plurality of segments or blocks or carbon or graphite, or a mixture of both which provide for the proper lubrication of the parts. A cast-iron yoke is secured to a suitable support, and this yoke surrounds the collector-ring, but is spaced therefrom. A contact-ring is sprung upon the carbon collector-ring and is secured to the yoke by S-shaped springs. The ends of this contact-ring are separated a slight distance, but are yieldingly forced together by a pair of blocks connected by means of a bolt and a spring. Current is supplied to the contact-ring by leads which are attached to the yoke. By this means it will be seen that the entire periphery of the collector-ring is in engagement with the contact-ring, and thus a large surface of contact is assured.

A new electric furnace especially fitted for the reduction of sodium compounds has been patented by Mr. Alfred H. Cowles, of Cleveland, Ohio, who has assigned his interest to the Electric Smelting and Aluminum Company, also of Cleveland. The furnace proper may be constructed in the ordinary manner with the electrodes and feed chute, the main walls, however, being of porous carbon so as to be permeable to permit gases or vapors passing therethrough from the furnace chamber. Enclosing the porous carbon walls is a metallic double-walled jacket, the space between the walls and the jacket forming a condensing chamber, and the jacket being constructed to permit of the circulation of water therethrough. The operation of the furnace is as follows: Aluminate of soda with coke or carbon is charged through the hopper

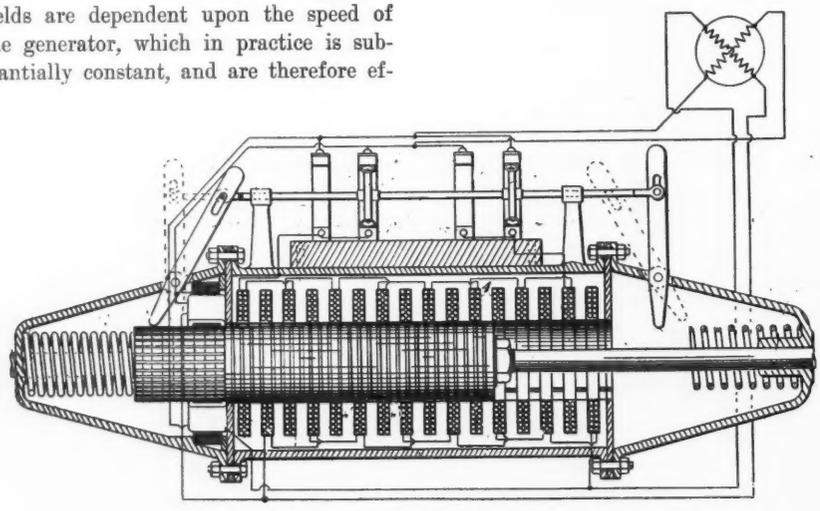


ELECTRIC FURNACE.

into the furnace, in which it is fused, thereby causing the sodium to distill off rapidly along with the carbonic oxide produced by the reduction of the oxide of aluminum. These gaseous products readily pass through the porous carbon walls into the condensers, being strained from dust in their passage by the walls. The vapor of sodium is immediately condensed when it comes into contact with

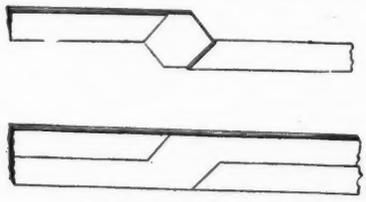
the comparatively cool surface of the jacket, whereupon it may be drawn off in liquid form, while the carbonic oxide after being condensed passes off through a suitable outlet pipe.

Attempts are being made to devise an efficient and practical reciprocating electric motor which can be operated by polyphase alternating currents. In this line it has been proposed to so construct a cylindrical electromagnetic motor or engine that longitudinally-shifting magnetic fields produced therein by means of polyphase currents may be alternately reversed in direction by means of switching devices operated by the generator which supplies the current to the motor, and thus effect a reciprocatory movement of the secondary member or armature. Such an arrangement is unsatisfactory, because the reversals of the magnetic fields are dependent upon the speed of the generator, which in practice is substantially constant, and are therefore effected without regard to the natural vibratory period of the secondary member or armature, in which case the secondary member will not start up from a state of rest unless its natural vibratory period is the same or approximately the same as that of the reversals produced by the generator-switching devices, and in practice this is a condition extremely difficult to secure. Mr. Ralph D. Mershon, of New York city, has invented what he considers a decided improvement in these machines, and the Westinghouse Electric and Manufacturing Company has purchased the patent obtained thereon. In his motor, the primary member consists of a metallic shell provided interiorly with a laminated iron core having annular grooves or recesses, in which are located the magnetizing or field coils. These coils are alternately divided into two sets, one of which is connected to conductors which are supplied with currents of one phase, from a two-phase generator, while those of the other set are connected in series to conductors which are supplied with currents in quadrature with those supplied to the other conductors. By this means it will be seen that a longitudinally progressive magnetic field is provided, this field being reversed by means of two switches secured to a sliding rod which is connected to pivoted levers arranged to be operated by the reciprocation of the secondary member slidably located within the metallic shell. This secondary member is in the form of a cylindrical body which may be either solid or built up of metal rings or plates supported upon a rod or shaft, the rod or shaft being journaled in the end-plates of the casing. The machine, as thus described, is well adapted for drills and trip hammers or any other tools to which it is desired to impart a reciprocating motion. When employed for drilling purposes, however, it is desirable that an intermittent rotation be given between the successive strokes, in order that the chisel may strike the material operated upon at different angles. To this end, one portion of the primary member is provided with a laminated core constructed to form a rotary magnetic field. The corresponding end of the secondary element has longitudinal conducting bars or rods, in order that a rotary movement may be imparted to the plunger when any part of it is in the rotating magnetic field. Any of the well-known forms of winding may be used in connection therewith. By this means it will be seen that when the secondary member returns after a stroke it will be given a slight rotary movement before the next longitudinal movement takes place.



Reciprocating Electric Motor.

In order to avoid excessive production of eddy currents in armature or other conductors, such conductors are frequently built up of a large number of strands or wires twisted together like the strands of a rope or cable. This construction is objectionable, both on the ground of expense and for the reason that the amount of metal comprised within a given cross-sectional area of the conductor is considerably less than where the conductor is solid. This latter objection assumes considerable importance in the construction of armatures and dynamo-electric machines in which it is desired to crowd as much copper as possible in the given space. Mr. Edward D. Priest, of Schenectady, N. Y., has been giving some attention to the matter and has finally evolved a method which does away with the objectionable features, and at the same time has the advantage of the twisted strands. The patent he has obtained thereon has been purchased by the General Electric Company. His idea is to make the strands of flat sheet metal strips, which are doubled longitudinally with the exception of their points of intersection or crossing. At this point the single thickness is left so that there will be no bulging, but a smooth, level surface will be maintained. In carrying out the construction, the flat strip or blank is cut half way through from one side, and half way through from the other, the distance between the two cuts being substantially equal to the width of the strip. The strip is then folded longitudinally from the opposite sides with the exception of the portion between the cuts. As a result, the folded portions are offset from each other, and extend in opposite directions from the unfolded pieces. These unfolded pieces form the point of crossing, and as it has the same cross-sectional area, there is no danger of heating at this point.



Armature Conductor.

Three-phase current is going to be used on a comparative long French line —that which runs from Grenoble to Uriage, and which now works with steam traction. The necessary energy, at a pressure of about 30,000 volts, will be taken from the works situated on the Laffrey lakes. If this scheme meets with success, other lines of the district will be transformed in the same manner.

A Combined Railway and Lighting System in Switzerland.

The Alstaetten-Berneck Electric Railway and the Electric Lighting of Alstaetten, in the Northeast Portion of Switzerland.

By Enrico Bignami.

THE INSTALLATION described below is an example of a mixed system—traction and lighting—which seems worth while to describe because it is a model of its kind—a kind which, it is thought, will become more general in small places where analogous conditions are found.

Much difficulty has been caused in the direction of the Central Switzerland railways by the number of trains of a local class required in the Rhine valley district. In spite of all that have been put on, the service is not sufficient for the increasing traffic, for example, between the small town of Alstaetten and the villages of Herbrugg and Berneck (see Fig. 9), in the canton of St. Gallen, which is one of the busiest districts in Switzerland. For some time the need of a railway connecting these three localities has made itself felt. Since much water power was to be had in the neighborhood of Alstaetten, the construction of a tramway with electric traction was indicated, and a company undertook the construction and exploitation of the line and also of the electric lighting of Alstaetten. In order to avoid any suspension of service it was decided to put in an auxiliary steam plant to take care either of a failure of the water supply or of such increment of travel as might be expected, on market days for example. The Oerlikon Company was given charge of the entire installation.

For the reasons mentioned above the installation was divided into two parts, a water-power plant at Weidest and a steam plant at Schönthal, with the water-power station at Weidest. The water power necessary for this plant is taken from a brook known as the Brendenbach and from the Ebenackerquelle. To impound the waters of the brook, a rectangular reservoir of masonry was constructed, having a capacity of 1,200 cubic yards (Fig. 1). From this reservoir a pipe 10 inches in diameter and 1,800 yards long leads the water to the turbines. The water pressure at the wheels is 225 pounds per square inch and the total height of the fall 492 feet. The quantity of water available, which is exceedingly variable, averages 55 litres per second, and may well be judged from the view of the brook shown in Fig. 2. The waters of the Ebenackerquelle are taken at a distance of about 1,500 feet from the central station. These are caught in a reservoir of 300 cubic yards capacity, and led to the turbines through a cast-iron pipe one foot in diameter. The total fall is 320 feet and the quantity of water is very constant at 70 litres (about 17 gallons) per second. About a mile from the centre of Alstaetten is the building of the power plant.

FIG. 1.—IMPOUNDING RESERVOIR FOR THE ALSTAETTEN STATION.

FIG. 2.—THE BRENDENBACH

Of the two wings of the building one consists of an old dwelling-house and the other of a brick annex. This quaint building is shown in Fig. 3. The ground floor is entirely given over to the machinery installation, while the second story is used for lodgings for the personnel of the plant. Two water-power units are installed in this building, together with the switchboard.

The unit worked by the spring water consists of a 100-horse-power turbine, running at 600 revolutions per minute, and direct-coupled to an alternator. The second unit, driven by the Brendenbach, consists of a high-pressure turbine of 70 horse-power, running at the same speed and direct-coupled with a direct-current dynamo. The turbines are of the horizontal-axis type and are furnished with automatic regulation. This is intended to deaden the violent shocks caused by quick variations in the flow of water in the long

pipes. Elastic couplings are used between the dynamos and the turbines. Single-phase current at 2,100 volts is generated for lighting, the secondary being fed on a three-wire system with 120 volts on each side, while the standard pressure of 600 volts is maintained for the railway service.

Fig. 3.—The Alstaetten Power-House.

The alternator is of the inductor type, built by the Oerlikon Company, and generates current at 50 cycles per second at 2,100 volts. Both the field and armature windings are fixed, the inductor alone rotating. In Fig. 4 is shown the interior of the generating station, showing both the alternator and the direct-current generator.

The direct-current machine is of the ring type, four poles, compound-wound, and presents no points of particular interest. The switchboard consists of two panels, one for the generator and the other for excitation, and carries all the apparatus and measuring instruments necessary for the service of the two machines. The lighting of the building is so arranged that it may be fed from the other power station in case of accident.

SCHÖNTHAL POWER STATION.

The reservoir steam station situated at Schönthal, about a mile from the station described above, consists of a single one-story building, containing all the necessary apparatus. It is shown in Fig. 5. In this station are situated two generators operated by a steam engine of the "Locomobile" type, having two flywheels, one working each of the generators. This curious engine and boiler combination is shown in Fig. 6. The boiler is worked at a pressure of 135 pounds to the square inch and the machine develops 50 horse-power when working at 120 revolutions per minute. The engine is compound, the high-pressure cylinder being provided with valves of the Frisch system.

The two generators are so arranged that their axes coincide and may be coupled if desirable. This arrangement and the switchboard are shown in Fig. 8. The alternator is of the type known as self-excited. Upon the shaft of the direct-current machine is a fast and loose pulley, permitting the engine to drive the generator without turning over the railway machine, should this be desirable. The switchboard takes care of both machines and the outgoing circuits, both for power and lighting. A necessary feature is a pair of phase lamps for coupling the single-phase machines in the two stations, when this is desirable. There is also upon the switchboard a reverse-current circuit-breaker to be used when the apparatus is feeding storage batteries, to avoid the dynamo being "motored." Circuit-breakers are placed in the outgoing feeders together with the totalizing wattmeters, etc., and an ohmmeter by which the condition of the insulation of any circuit may easily be read.

Upon the tramway circuit is connected a battery of 300 elements of which 270 are normally in circuit, the others acting as end-cells. The battery is of 60 ampere-hours' capacity on a one-hour discharge, but can withstand a discharge of 120 amperes for ten minutes, and even of 180 amperes for a few seconds.

OPERATIONS OF THE TWO STATIONS.

The Schönthal installation, which serves as a reserve plant, is employed when the water power at the Weidest installation is not sufficient, also during days of heavy traffic (market days). It is readily evident that a number of combinations of the two stations in the line are possible. One of the most interesting is when it is desired to feed railway lines heavily. The alternator at the Schönthal station may be driven from the other alternator as a synchronous motor, and itself drive the railway generator at Schönthal. This can be done without starting the steam plant

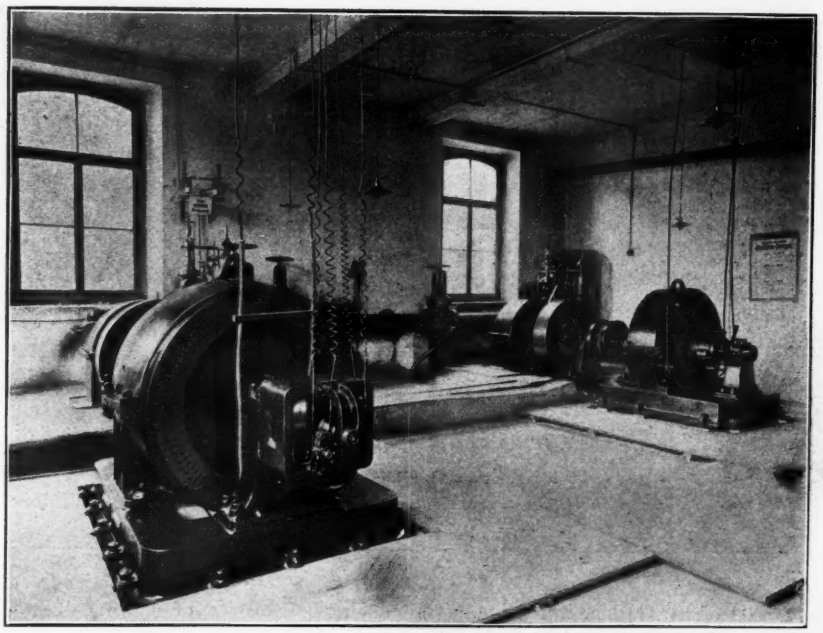


Fig. 4.—Interior of the Alstaetten Power-House.

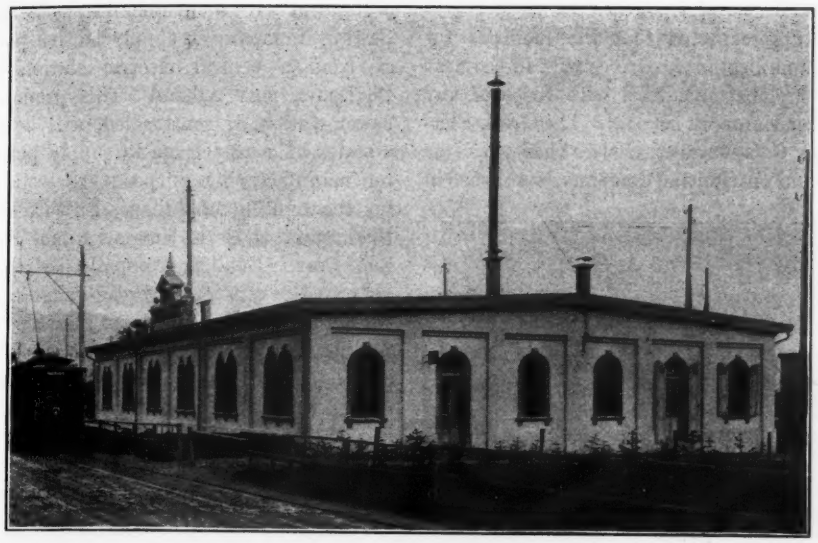


FIG. 5.—THE SCHÖNTHAL POWER-HOUSE.

by bringing the machine up to synchronism, using the railway generator as a direct-current motor driven from the battery of accumulators for this purpose.

THE ALSTAETTEN-BERNECK RAILWAY.

The line which runs from the railway station at Alstaetten to the hotel at Berneck is 11.6 kilometres (7.2 miles) long and follows the state road. The maximum grade is 5.2 per cent, while the medium grade is 1.4 per cent with curves having a minimum radius of 80 feet. The gauge is one metre and automatic switches are used throughout. The overhead trolley system is used, the rails being bonded with copper wire one-quarter inch in diameter for a return circuit. The trolley wire is eight millimetres (about three-eighths inch) in diameter and is swung from gas-pipe side brackets attached to the poles. This wire is divided into two separate sections fed from the Schönthal switchboard. No feed wire is used.

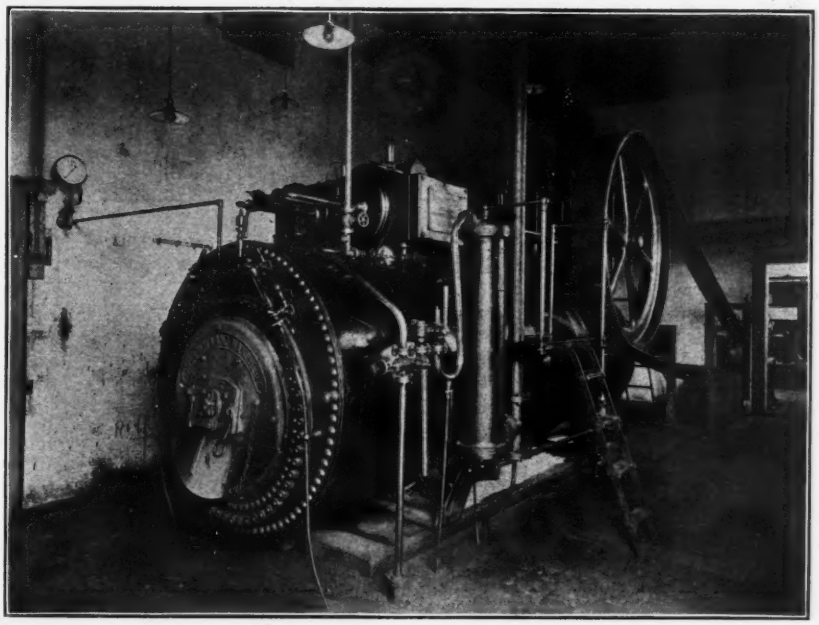


FIG. 6.—"LOCOMOBILE" ENGINE AT SCHÖNTHAL

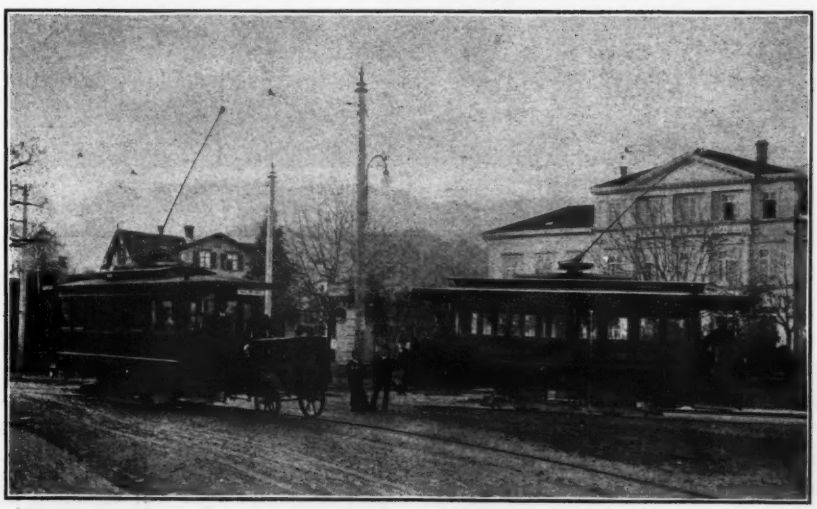


FIG. 7.—MOTOR CARS OF THE ALSTAETTEN-BERNECK RAILWAY.

Seven motor cars of the type shown in Fig. 7 are used, these being mounted on very solid trucks built up of steel shapes. The front part of the brake is curved to form a snow-plough, and in front of each wheel is carried a brush. Screw brakes are used, operated from either platform. The cars seat 30 passengers, and each is divided in two compartments, one of which is for smokers. The cars were built in Nürenberg. Six of the cars are furnished with 18-horse-power motors, and each is lighted with six incandescent lamps. The seventh car is provided with two motors, so it can be used with a trailer if this becomes necessary. In Fig. 7 is shown a method by which the mail is delivered between the two towns, the small truck attached to the back of the car being the mail wagon. A car shed with a capacity of eight cars is provided at one end of the line.

According to the season of the year from 16 to 21 trips are made daily in each direction, between six o'clock in the morning and nine o'clock in the evening. Each trip is divided into eight sections for collecting fares. In any one section the price is 15 centimes (three cents); for each following section the price of five centimes (one cent) additional is charged. The whole plant cost, complete, about $110,000, or without central stations a total cost of $9,200 per kilometre or $7,200 per mile. In 1900, 464,651 passengers were carried and a net earning of 16,446 francs, or over $5,000 was shown.

ELECTRIC LIGHTING AT ALSTAETTEN.

Single-phase alternating current at 2,100 volts and 50 cycles generated at

either station is used for lighting the town of Alstaetten. The transformers are all in the Schönthal station, whence the three-wire low-tension network has its point of departure. All of the secondary wiring is overhead, 1,200 lamps being connected with it. A meter system of

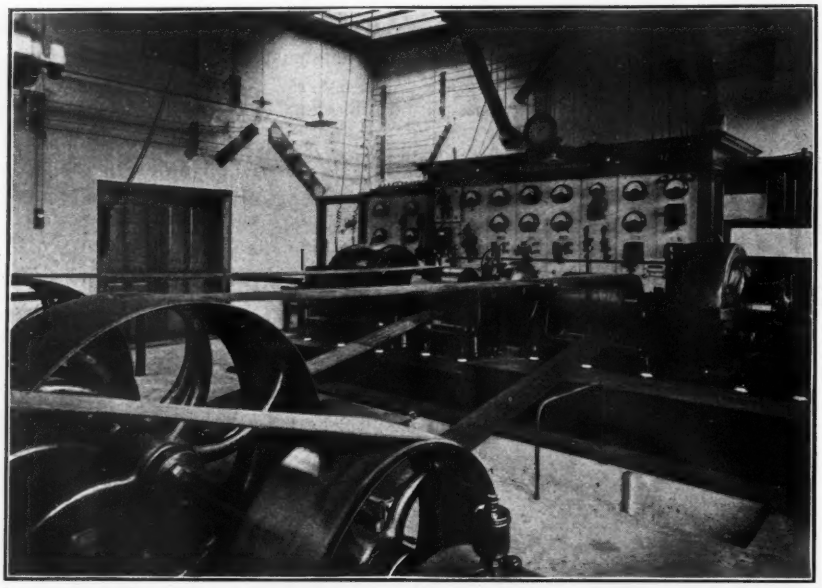


FIG. 8.—DYNAMOS AND SWITCHBOARD IN THE SCHÖNTHAL STATION.

charge is used, and lamps as small as five candle-power are burned. The price per kilowatt-hour ranges from 50 centimes to 34 centimes (10 to 6.8 cents).

This interesting little installation for railway and lighting showed a good profit on the investment made in it during last year and is exhibiting a constantly increasing earning power.

Sugar Produced by Electrolysis.

M. Dupont has been conducting some interesting experiments in the electrolytic production of sugar. The electrolyzer consists of a wooden trough which is divided into three compartments by means of porous partitions of porcelain, asbestos or parchment paper. Metallic plates are used for the electrodes, and they vary according to the object to be obtained. They may be composed of platinum, aluminum, lead, zinc, etc. In order to obtain sugar from cane or beet juice, the saccharine fluid is placed in the central compartments, and the end compartments are filled with water. Under the influence of the current, the albuminoid substances of the juice coagulate and precipitate, and the salts are decomposed. The juice becomes clear, limpid and colorless, and no longer contains anything but sugar and some traces of organic matter. There seems to be osmosis through the partitions. In the end compartments accumulate the soda, potassa and ammonia. It is not certain that the process can be used commercially. It is probable that it will in time become useful for work on a commercial scale. It is useful now for analysis.

Electrical Progress in Greece.

It is expected that the facilities for communication in Greece will, in the near future, be on a level with those of any other European country. The Greek Electric Company, otherwise known as the Thomson-Houston Company, established in

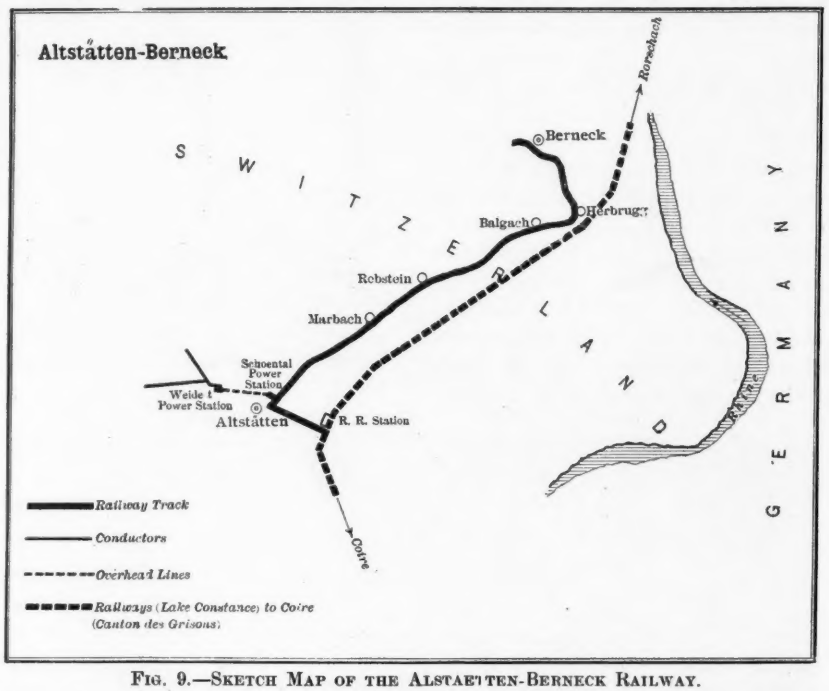


FIG. 9.—SKETCH MAP OF THE ALSTAETTEN-BERNECK RAILWAY.

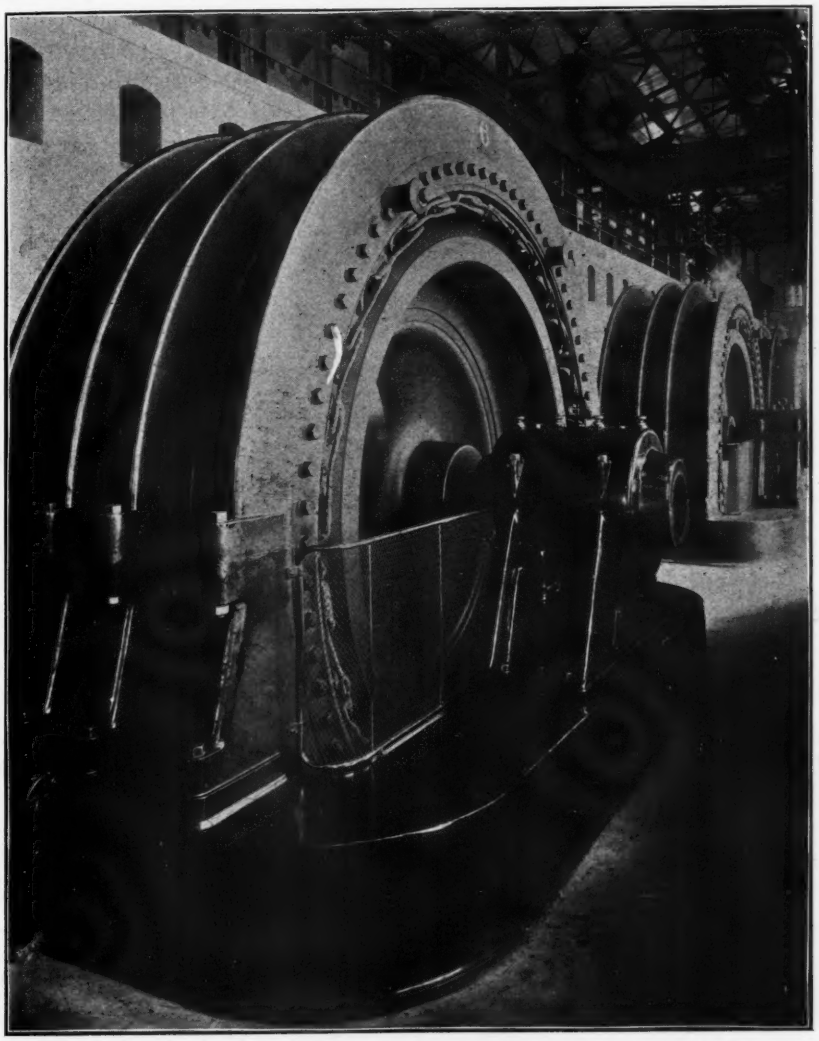
1898, with a capital stock of 10,000,000 drachmas ($1,250,000), of which 5,000,000 drachmas ($625,000) is paid up, is now completing in Patras the first electric street railway in Greece, and in fact in the East. The same company operates the gas company of Patras, the electric light plants of Athens and Piræus, and of four or more other cities, and is now negotiating with the Athens-Piræus Street Railway Company to supply motive power from a central electric station at Phalerum, near Athens. This proposed power station, if constructed, will be on a scale sufficiently large to supply power for manufacturing purposes, as well as for the lighting of Athens, Piræus, and Phalerum. It is also current rumor that the Franco-English company, already organized to construct a broad-gauge railroad through the north of Greece to Athens, will soon begin operations. The completion of this road will connect Greece with the north of Europe by rail, and trains will be run from Paris to Athens direct *via* Constantinople.

The street railway in Patras will be similar to that found in general use in France and Italy. The road has been constructed entirely of iron and with considerable dispatch. The motive power will be furnished by gas motors of German construction. The steel rails are from Belgium, while from the United States there will come—from the General Electric Company of New York—the material for the aerial line, insulators, circuit brakes and car motors; and—from the John G. Brill Company—the trucks for the cars. The main stem of the road is constructed the length of the city, parallel with the sea, and extends some distance beyond the city limits, to a point suitable for coffee-houses and baths. Business men generally believe the road will prove of great benefit to the city, but are skeptical as to the results to the company. It will probably be some time before the road will become a paying investment.

The Chambly-Montreal Power Transmission.

An Important Medium-Distance High-Tension Two-Phase Transmission Line in Canada.

LYING south and somewhat to the east of Montreal, in Quebec, the historic village of Chambly is situated at a point where the Richelieu River, the outlet of Lake Champlain, descends in a series of rapids and furnishes an abundant and unfailing supply of water power. Ever since the days when the ill-fated army of General Burgoyne made its winter quarters at Chambly previous to the march along Lake Champlain to defeat and surrender at Saratoga, mills had been at work using the water power of this river in the manufacture of flour, and, in later years, of textile fabrics. On account of the peculiar conditions surrounding the watershed of Lake Champlain the power is practically constant the year through at Chambly, and, while the fall is low, the volume of water is large and it has been comparatively easy to erect works to develop a very considerable energy at the falls, all of which is available for use in the thriving city of Montreal, 17 miles away.



TWELVE-THOUSAND-VOLT, TWO-PHASE, 2,000-KILOWATT DYNAMOS IN THE CHAMBLY STATION.

In order to utilize the water power a dam of solid concrete, strengthened by an admixture of iron tie rods, was built across the river, a middle section running upstream and giving the whole structure somewhat the appearance of the letter N. In the lower part of this dam was built the power-house, integral with the concrete structure of the dam itself, and one of the first of the modern type of submerged turbine power-houses which are now becoming rapidly more plentiful. The head of 31 feet is almost equally divided between a pressure head on the submerged wheels and the fall obtained in the draught tubes leading to the tail-race below. The illustrations give a better idea of the general plan of the power-house buildings and the dam and of the method of mounting wheels and dynamos together on a single shaft than can any description.

Each set of wheels working together as a unit is mounted on top of its draught tubes in a chamber formed in the solid concrete, four wheels, having runners 48 inches in diameter and alternately of the right and left-hand pattern, being connected to each shaft. In the preliminary equipment, with which the plant was opened for service some four years ago, there were included four 2,000-kilowatt Stanley alternators, of the inductor pattern, giving quarter-phase current at 12,000 volts in each phase directly, and running at 153 revolutions per minute. The frequency is 66 cycles per second. In addition to these there were two direct-driven exciters, each having its own separately controlled waterwheel and the usual switchboard combination. At present a new installation is going in, the photographs distinctly showing the work of setting the new dynamos. These consist of four generators of 2,200-kilowatt capacity each, built by the Canadian General Electric Company, and each developing quarter-phase current at 2,200 volts in each phase at the standard speed of revolution. These machines are of the revolving field pattern, the field coils being wound of copper scrap put on edgewise and bolted to a nickel-steel ring of generous dimensions. As soon as these units are in operation the older machines will be rewound for the same tension and operated in parallel with the new ones. At present—that is, while the old equipment only is running—there are no transformers in this station except those necessary for station lighting and for the lighting of the villages of Chambly and Chambly Basin. When the new installation is complete 10 transformers will be installed, each of 2,750 kilowatts capacity, these machines being of the Westinghouse air-blast pattern. It is intended to use these for stepping-up the current simultaneously to 25,000 volts

and to three-phase by the usual Scott arrangement, thus utilizing the higher efficiency of three-phase transmission for the line.

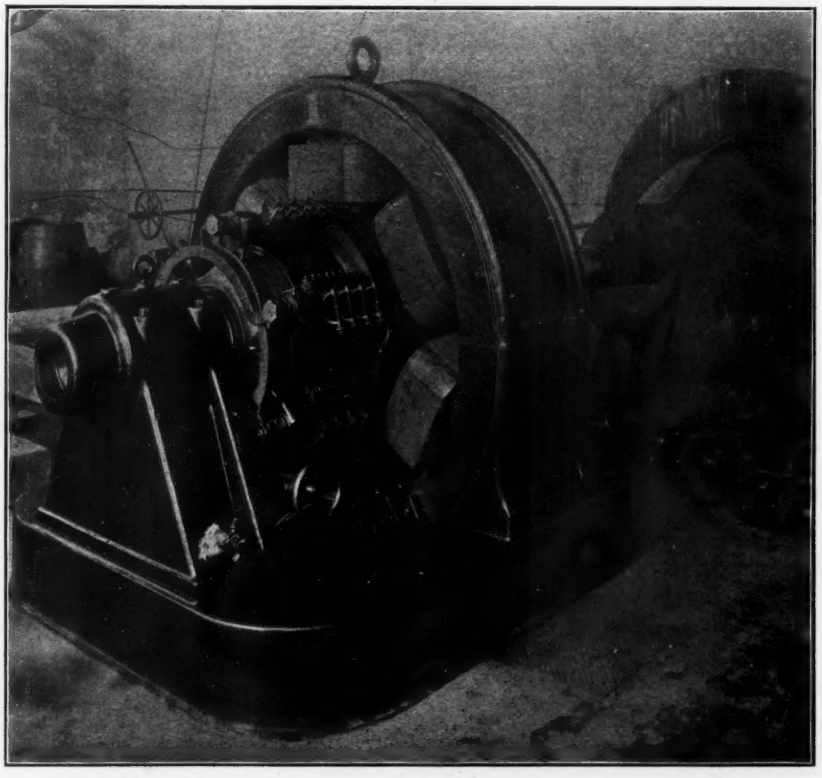
A few more details of the power-house equipment may not be uninteresting. The exciters are each of the six-pole type, of 140 kilowatts capacity, and give current at 100 volts. The building is spanned by a Shaw crane, electrically driven, of 40 tons capacity, which is well shown in the interior view of the main power-house. The switchboard is of the type now so commonly employed in high-tension generating stations, in which all of the low-tension apparatus and handles for governing the high-tension switches are mounted on a board of white marble, placed in an elevated gallery from which a view of the entire installation may be had, while the high-tension parts themselves are in an upper gallery entirely separated from that portion of the board which is handled by the operators. The lines leave the high-tension board in rubber cables which, like all the rest of the cable employed about the power station and transmission lines, was made by the Washburn & Moen Company, of Chicago, and after passing through exit openings, made of glazed tile sewer-pipe corners, passes to a terminal house, whence the power-transmission line for Montreal emerges.

The line is perhaps the most interesting feature of the Chambly-Montreal transmission. It is erected on two sets of cedar wood poles about 30 feet long, at present each cross-arm carrying one complete four-conductor line for the two-phase transmission system. At present there are three lines, making a total of 12 wires connecting the two points. The line is run on heavy white porcelain insulators, which are tested to 30,000 volts before being put in place, and No. 00 bare copper wire is used throughout on the aerial portion of the line. Unlike the majority of transmission lines, this one is composed of a considerable number of succeeding aerial and underground sections, as may be seen from the following table, giving the lengths and feet of each division of the line from the power-house to the receiving station in Montreal:

	Feet.
Aerial	5,400
Submarine	140
Aerial	68,153
Subway	9,200
Aerial	1,650
Subway	1,776
Submarine	285
Subway	1,015
Total	87,619

or 16.59 miles.

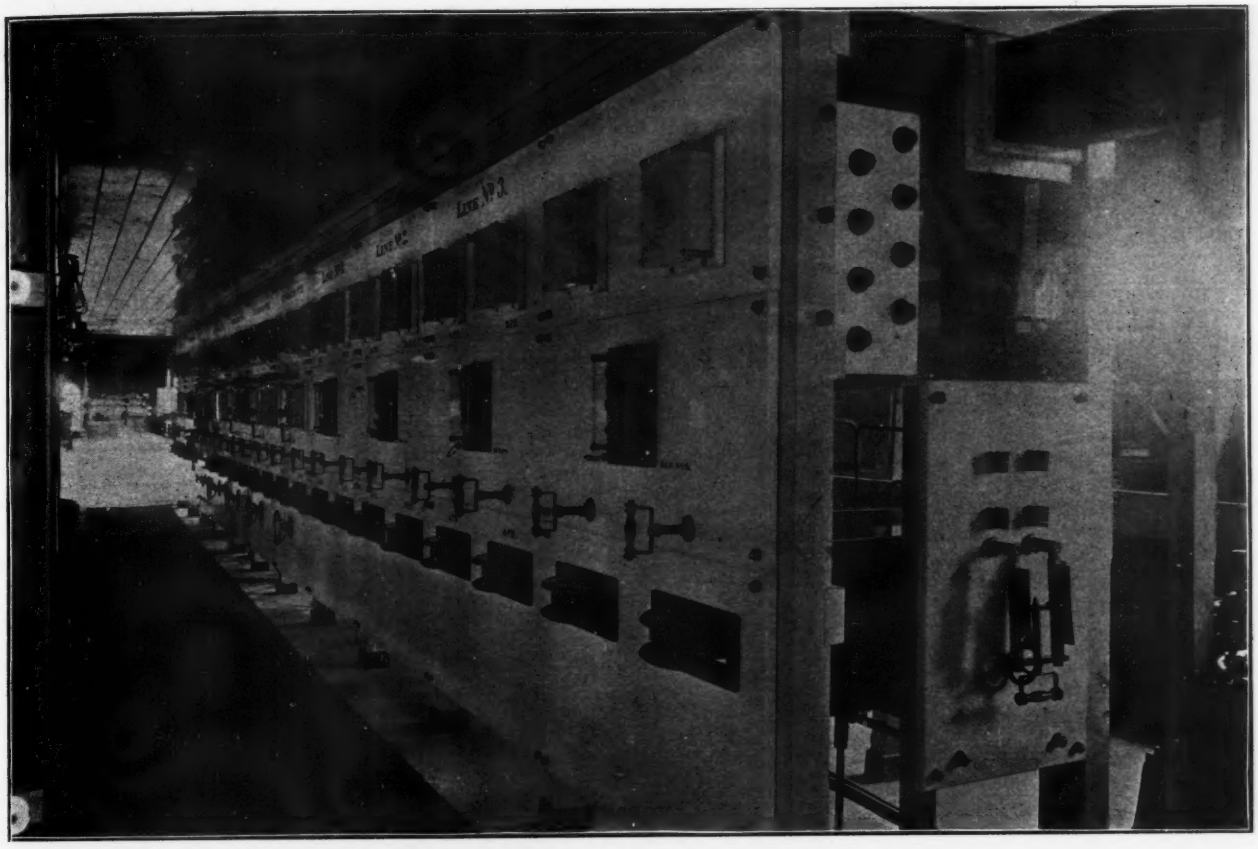
It should be stated that the sections marked "submarine" refer respectively to the crossings of the Richelieu Canal and the Lachine Canal in the city of Montreal. Along the length of the aerial line three strands of ordinary barbed galvanized iron fencing wire is strung, one being put at each end of the upper cross-arm and one strand on top of the poles. This wire is mounted on pony glass insulators, although it is grounded at every pole by means of iron wires connected with iron earth-plates buried under the foot of the pole, the grounding wires being protected by an iron pipe passing down the side of the pole. The insulators were adopted for reasons of mechanical strength, since the galvanized iron wire is apt to rust and break if attached directly to the wooden cross-arms or poles. This construction on the aerial parts was decided upon, after some consideration and in the face of no little prediction of its failure, as the most efficient protection that could be had against lightning.



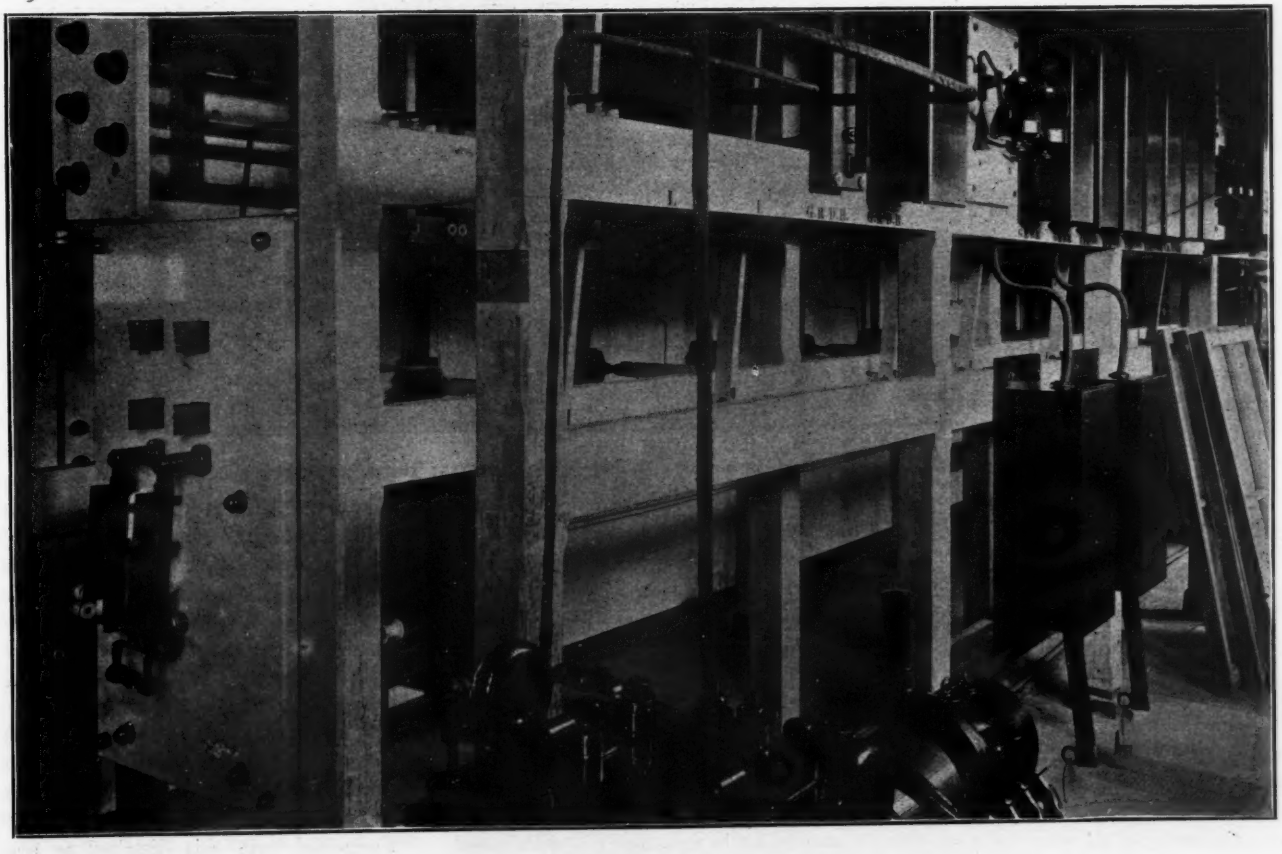
One of the Exciters at Chambly.

Lightning storms in the valley of the St. Lawrence River, while perhaps not so frequent as they are in other climates, are sufficiently so to cause grave anxiety to central station managements, while the severity of the storms is marked. After some experience with the barbed wire all other forms of lightning protection whatever that were in use on the transmission line were discarded and disconnected, and for two summers past the barbed wire has been the only protection which the line has possessed. Notwithstanding this it has gone through severe thunder-storms without the slightest trouble and even without the customary fireworks and disturbance at the terminals. Indeed, so well has barbed wire proved its case in this connection that the Royal Electric Company, of Montreal, which is the owner of the transmission line, has experimentally equipped two sections of its distributing network in Montreal with the same variety of protection, with the gratifying result that upon them no troubles have been had whatever with lightning during the past summer, while other portions of the network furnished with arresters of the ordinary types have been more or less troubled with lightning discharges. Near the terminal house at the Chambly end of the line is an arrangement whereby a load can be placed on one of the lines, for testing generators for example, by lowering metallic plates connected to the cables above into the tail-race. An interesting result which has followed every test that has been made so far with this apparatus has been the killing of a number of fish in the tail-race as soon as the current is turned on.

One of the most interesting features of the transmission line is its crossing over the fine Victoria Bridge, connecting Montreal with St. Lambert, on the south-



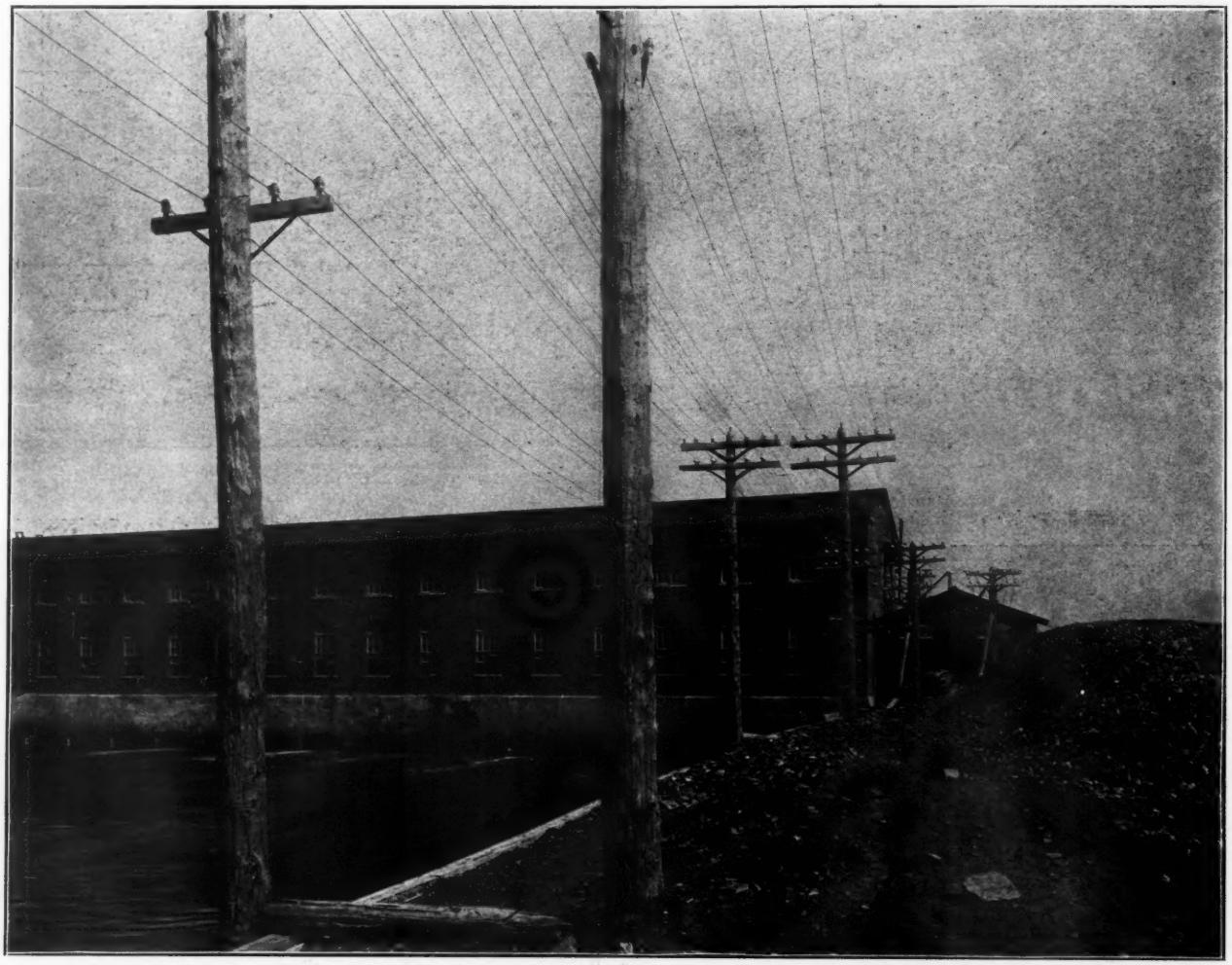
FRONT OF THE SWITCHBOARD AT CHAMBLY, SHOWING CONTROL HANDLES.



REAR OF THE CHAMBLY SWITCHBOARD.

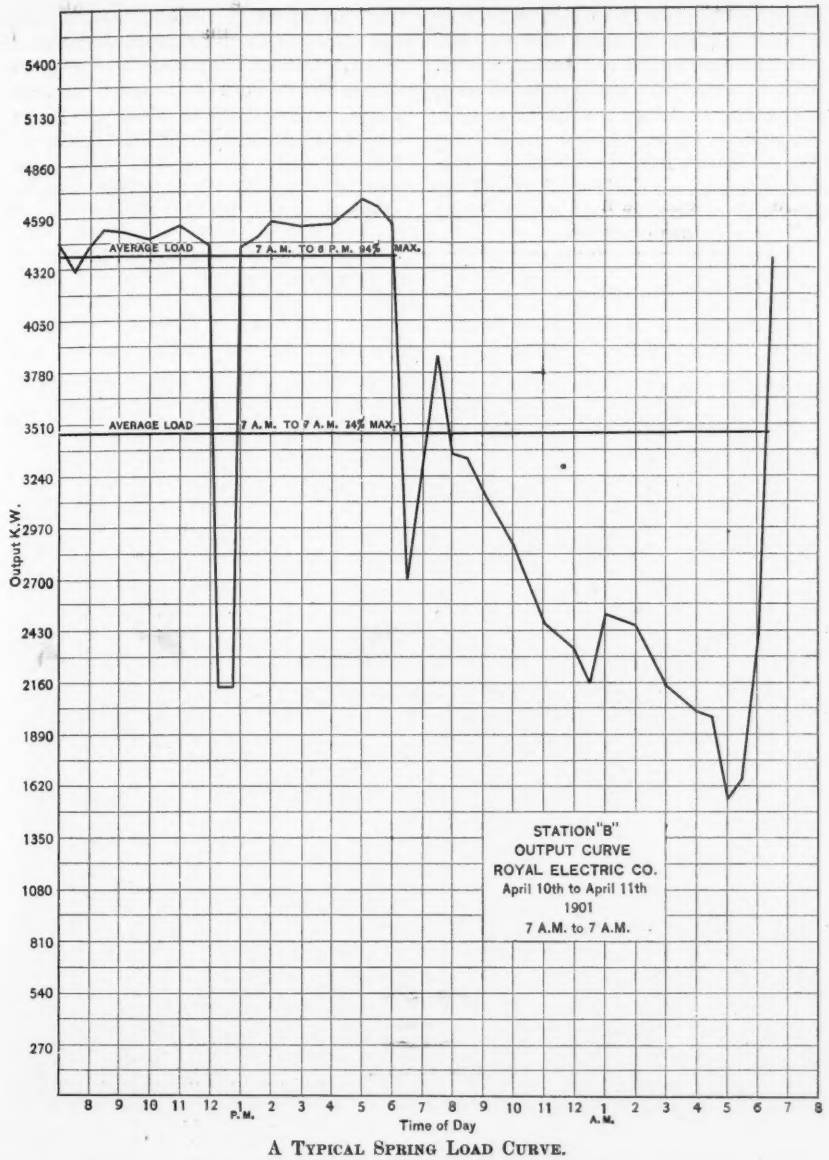
ern side of the St. Lawrence River. This bridge, it will be remembered, has lately been built to replace the historic tubular bridge—a kind of aerial tunnel—which was formerly regarded as a wonder of railway engineering. The new bridge is a substantial steel truss structure having a double railway track, roadways and walkways. Its total length is 6,700 feet. Naturally it was considered important upon this bridge to protect the circuits most carefully. The difficulty experienced on other bridges crossed by electric cables, both by vibrations incident to the traffic on the bridge and from the creeping action of cables laid upon a structure which rises to a high point in the middle with grades down toward both ends, made the problem in many ways a serious and difficult one. A wooden box, 8 by 11 inches inside, was laid across the bridge and in this the cables were laid down, the sheaths for these sections of the cables being made of pure lead without tin alloy, this being less liable to exhibit crystalline fracture and other difficulties. At each joint of this cable the joint was solidly imbedded in plaster of paris, thus forming both a fireproof protection in case of trouble with a short-circuit at a joint and a solid anchorage for each short length of the cable. This construction has proved very satisfactory in practice, and no trouble at all has arisen from the bridge crossing. It is proposed to install the new cables for the 25,000-volt transmission on top of the bridge trusses.

The present receiving station for the transmission line is the generating station of the Royal Electric Company, in Queen street, in Montreal. This station has been in operation since electric lighting was first introduced in the Canadian city, and contains an exceedingly interesting collection of apparatus representing various degrees of engineering development. At present the bulk of the transmitted energy is received in a battery of oil-insulated water-cooled Stanley transformers, whence it is redistributed to the various working circuits about the city at 2,200 volts in each phase, a two-phase transmission being adopted. An interesting feature of this transformer room is that it is situated below the water level of the near-by canal, and the water for cooling purposes is circulated by gravity through the transformers, the cold water entering at the bottom and leaving at the top as it is warmed by contact with the transformer oil. The most interesting feature of the station, however, is the use of synchronous motors operated directly by the incoming line current, these machines being used both for driving arc machines for street lighting at night, for working other machinery during the day, and running light with over-excited fields to compound out the induction factor of the line and bring up the power-factor of the system to unity. By this method the power-factor is kept normally as high as 96 per cent, the men at the switchboard having become very expert in regulating the field excitation of the balancing machines in order to bring about the desired result. In the daytime one 750-kilowatt synchronous motor is ordinarily used for this purpose.



THE CHAMBLY-MONTREAL TRANSMISSION LINE LEAVING THE TERMINAL HOUSE AT CHAMBLY.

Connected with this distributing station are about 125,000 16-candle-power



A Typical Spring Load Curve.

incandescent lamps, 2,000 arc lamps and a total capacity of over 6,000 horse-power in motors. A large part of this power is furnished to the Montreal Street Railway Company, but a very considerable total is taken by induction motors operating various manufacturing establishments and used for a variety of power purposes. One of these is for pumping water for a section of the city, a 540-horse-power induction motor being used for this purpose. In starting these large induction motors a friction clutch arrangement is used, permitting the motor to be started free, or else an auxiliary starting motor is used, these appliances being for the purpose of minimizing the heavy overload currents noticed when induction motors are started underload. It should be said here that all of the generating apparatus at Chambly is run in parallel and that the motor and lighting service of the city is supplied from the same bus-bars in the distributing station in Queen street.

Work has just been begun upon a new distributing substation near the site of the present station, which will be a model of its kind when completed. The building will be about 175 feet square and one story in height, and will contain all of the transformer and distributing apparatus, including the necessary synchronous machinery working as a dynamic condenser. It will be surrounded on all sides by a clear space of 75 feet, thus preserving it from dangerous contiguity to its neighbors in case of fire. It is hoped in a later issue to give an account of this fine substation and its contents.

The accompanying load curves show the evidence of a somewhat remarkable method which has been in vogue for a year or more past in Montreal for steadying the total daily output. For motor service it has been found that contracts could be made with manufacturing establishments and others whereby the hours of work could be made to conform to the light-load hours on the station system, and that in summer both manufacturers and operatives were willing to work longer hours, while in winter shorter hours were practicable, the motor load of factories going off before the lighting load of the evening begun. The load curves, which were taken in different seasons of the year, show respectively average loads of 85 per cent and 94 per cent of the maximum load, and this extraordinary result has been obtained entirely by concessions to manufacturers and other power users who were willing to regulate their hours of work in accordance

The Chambly-Montreal Transmission Line.

with the average demand of the city for power for all purposes. This result has been accomplished under the able management of Mr. Philip G. Gossler, the general superintendent of the Royal Electric Company. The new work of changing over the installation to 25,000 volts is progressing under the immediate supervision of Mr. Ralph D. Mershon, representing Mr. F. S. Pearson, consulting electrical engineer. The transmission line and system is one of the most interesting in Canada, if not in existence, and presents many points of extreme interest when it is considered that it is operated successfully and with satisfaction in the rigors of a Canadian climate and carries a large portion of the total lighting and power load of the largest city in the Dominion.

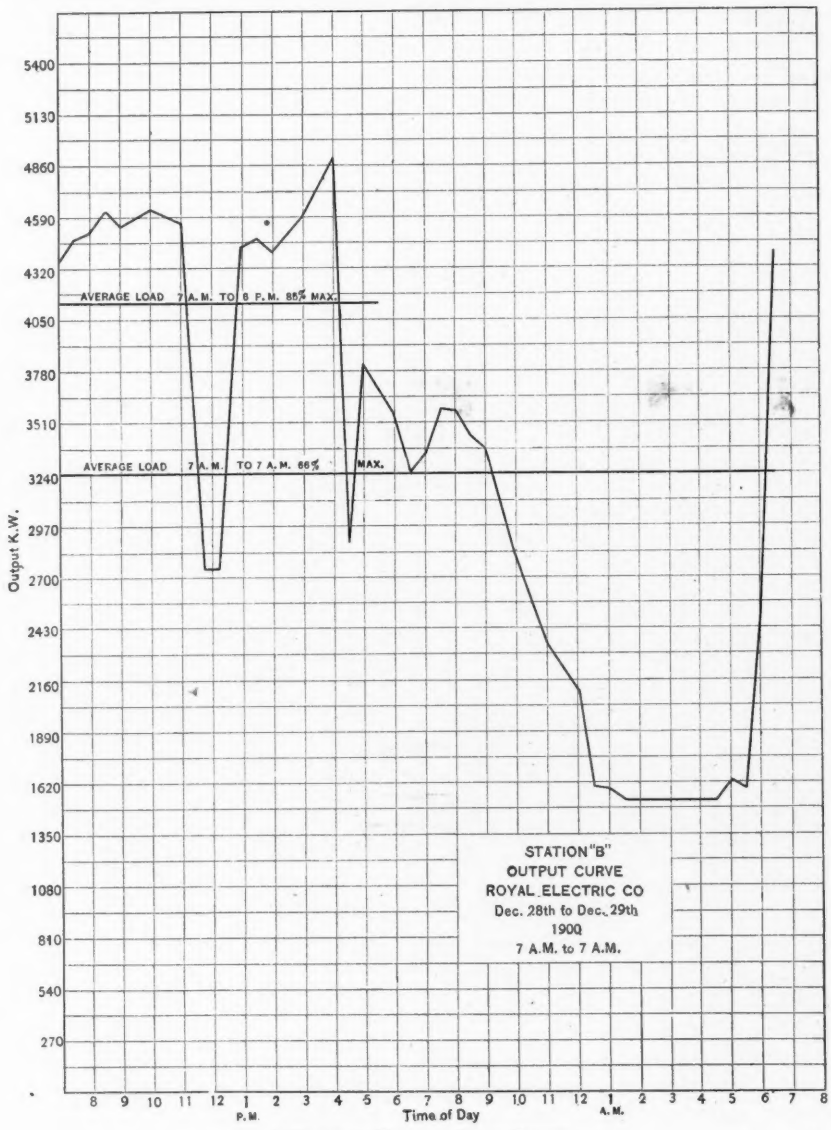
HOW TO OVERCOME DANGER TO FIREMEN FROM ELECTRIC WIRES.*

BY MORRIS W. MEAD.

In running overhead high-potential wires in the business portions of most cities, there is too much carelessness in the arrangement of the circuits. Experts of the large lighting companies, as a rule, know what is best and safest in the premises, but expense figures in the matter, and the superintendent who can construct the lines or run the plant the cheapest is too often the chosen one. For instance, a city lighting circuit, for street lighting, is too often run more like a circle, one side of it down one avenue or street, and then along another, then up a third or fourth street, with the other side of the circuit, so as to save a little wire in its construction, thus rendering it almost impossible to arrange switches so as to cut out properly the circuit in case of fire. By this arrangement a switch only cuts out one side and does not properly open the circuit. The opening of both sides of the circuit at the same time is essential to cut off all danger.

I believe all such electric light circuits should be run in parallel, and at regular intervals lead off to switches, and that such locations should be numbered and blue prints of every switch and location of every circuit prepared and kept on file at headquarters of the fire department. These should all be carefully studied and gone over either with an expert of the local company or with a competent city electrician. The firemen should even be trained and instructed in handling the switches, as well as in general electrical principles, so as to understand the easiest and safest manner of handling them in case of the emergency of a fire, as well as the difference in single and double-pole switches. Every circuit should be labeled at regular intervals with the voltage it carries, and all controlling devices should be made to correspond. Trolley wires can be arranged on the same principle, so as to be able to cut out at every 1,000 to 2,000 feet, in crowded cities, and these places carefully marked and records placed on file at department headquarters in every well-regulated department. Especially in the larger cities, one or two electricians should be attached to the fire department and go to all fires with the first district, just to assist in handling the matters as above outlined, as well as, in the meantime, to instruct the members of the department in self-protection from high-potential currents.

Next, one of the best remedies is for cities to compel all wires to be placed underground in the business portions of the cities and on all main avenues leading out of the central portion of the cities to the suburbs. Electric light companies in all cities can afford to do this, and legislative powers should compel its application. But in regard to trolley lines, all cities are not so built by nature as to make successful the underground trolley system. While New York city and Washington might successfully do this, yet I would doubt its feasibility in Pittsburgh or cities situated where there are so many hills or extensive raise in rivers, which sometimes cover the lower lands.



A TYPICAL WINTER LOAD CURVE.

The next step toward doing away with these dangers should be, to my mind, a complete city control over all these matters, ordinances should be passed placing supervision of overhead wires in the hands of a competent city electrician, or, as above suggested, compel underground construction. I am a believer in municipal control, as distinguished from ownership, especially in electrical matters, and believe that under competent city authority the dangers which you fear from electricity as firemen could be obliterated.

Once again, another safety arrangement which would naturally suggest itself in the protection of firemen, in fighting fires, from electricity would be that all electric

* Abstract of address before the International Association of Firemen at Indianapolis, August 27, 1901.

light and power companies, railroads included, should have thoroughly equipped wagons, located at reasonable intervals, along their lines, with competent men in charge to respond in every case of fire and thus be the means of one or more additional safeguards to those who are there to assume the responsibility of managing fire department matters. This, I should think, would be a good thing to do from the standpoint of economy to the companies themselves, to say nothing about the protection it would afford to those who have to assume the risk and danger. Gongs connected with the fire department both sides, side by side, or in parallel, taking both sides to a double-pole switch cutout, so that, in opening the switch, both sides are cut out at once, thus doing away with the liability of the grounded conditions above spoken of, which may come from either poor insulation or any other cause whatever. This condition should exist in all circuits carrying over 300 volts. Cutting a circuit under load is not always easy or safe, usually it is done one wire at a time, or, in electrical parlance, "one leg being down," and when the second leg or side is severed accidents are liable to occur. Thus a system of cutouts business parts of all cities and towns and along all main avenues leading to the outlying districts of the city. I would compel all feed wires to be placed underground for railroad purposes, and, wherever the local conditions warrant, to place the underground system in use.

Next, I would compel, where the wires are not underground, that all circuits be run parallel, or side by side, and at intervals of every 2,000 or 3,000 feet, lead off to properly protected and covered double-pole switch cutouts. That the voltage of every circuit be marked upon each circuit and located at regular intervals; next,

THE CHAMBLY-MONTREAL TRANSMISSION LINE CROSSING THE RICHELIEU RIVER.

lines should be in all such headquarters, and, if necessary, there should be two crews attached, to relieve each other, or else to sleep there regularly, as firemen do, and answer day and night.

Another suggestion that sometimes is a convenient arrangement to have on hand is that boots and rubber gloves be furnished to the firemen, and insulated pliers, which can easily and readily cut off wires in case of necessity. I only suggest these remedies which are the first to be thought of in case of the absence of the previous suggestions made.

The insulation on overhead wires very rapidly disintegrates through chemical conditions which exist in the atmosphere, as well as exposures to heat and storm effects; through these conditions there is always a variety of paths to the ground from escapes caused by defects in insulation, and especially in cases of rain or the existence of moist conditions, which always do exist in cases of large fires, so that it is absolutely necessary, as previously suggested, to have switch arrangement at various intervals, to run the circuits at prearranged intervals on all overhead lines carrying 300 volts or over should be located on maps and the same filed with the fire department and the municipal electrical bureau. This is one of the most practical and effectual ways of securing immunity. On large systems probably there would be considerable expense in furnishing these extra cutouts, but some provisions should be made for equipping and arranging a certain amount of old lines yearly, and all new work to be according to standard herein proposed; 2,000 to 3,000 feet is suggested as the best distance to separate cutouts—expense and safety considered.

In enumerating and closing, I would place:

First, a thorough municipal control—under one head—of all municipal electrical matters, backed up by a legislative power to compel compliance to reasonable suggestions in a reasonable way.

Secondly, I would compel all overhead wires to be placed underground, especially electric light and power wires, carrying 300 volts and over, in the that these locations, as well as the location of every circuit on each pole, be carefully mapped and blue printed, and copies left at the fire chief's headquarters and at the headquarters of the municipal electrician; that the men be carefully drilled as to the location of these cutouts and circuits, and in the proper methods of handling the same; that one or two men, competent electricians, be detailed to go to all fires; that the companies, both light and railroad companies, be compelled to have special wagons and outfits controlled by competent men placed at regular intervals through the business parts and built-up sections of the city, that they have gong attachments and all necessary communication features, with the fire department proper; that they answer every alarm, and that the men be compelled to sleep at these several locations, or that a duplicate force of competent men should be employed.

Next, that reasonable precautions to safety be furnished each fireman by way of rubber boots and rubber gloves and insulated temporary tools to be used in all cases of necessity.

CONSTRUCTION OF SMALL TELEPHONE EXCHANGES—XII.*

BY A. E. DOBBS.

INSIDE TERMINALS AND CONNECTIONS.

If terminal heads are used inside the exchange or terminal room, the method of connecting them up does not differ materially from the method pursued in the case of those outside. There are, however, several different methods of bringing in and connecting the outside

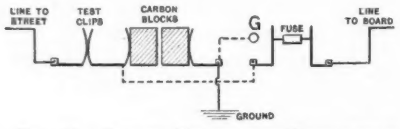


FIG. 46.—SKETCH DIAGRAM OF PROTECTION DEVICES.

cables, all of which possess their own advantages, so that we will stop long enough to describe some of them in detail.

The inside cable connections should make provision for the following appliances, either on the terminal head or the cross-connecting frame:

First—A lightning arrester of either metal or carbon plates in close proximity to another ground-plate, for the purpose of throwing static or other high-tension currents to ground. The most common form of this arrester consists of carbon blocks held apart by means of very thin strips of perforated mica or silk.

Second—A fuse or heat coil (which is practically the same thing) which will give way under a current not exceeding 0.25 of an ampere within, say, 30 seconds. Some of these heat coils or fuses are also so arranged that the line connection passes over a spring, held away from a ground-plate by the strain on the fuse wire, or heat bobbin. Should the fuse break the spring flies back against a ground-plate, which either cuts off the source of danger by shunting the intruding current to ground, or, if the current should be a heavy one, opens the heavier fuse in the outside cable box, thus preventing possible damage to the cable.

Third—A spring clip connected to the outside line for the insertion of a plug for testing purposes. This, however, is often omitted and clips on the end of a flexible cord used instead.

Fig. 46 is a diagrammatic sketch of this sort of a circuit, which may be mounted directly upon the cable head. It is now the general rule among cable men to make up the wires of the cable into a form as shown in Fig. 47 before connecting it to the clips. In this way all necessary testing is done before the cable is formed up, which makes soldering quick work. Before putting into place the form is generally soaked in paraffin to prevent the absorption of moisture by the paper covering, and a little more paraffin run down into the stem of the cable head to seal it up. It also naturally follows that the back row of clips should be connected to the cable first, as they can not be connected in after the front row is in place.

OTHER METHODS.

Protective devices are not always mounted on the cable head, as many engineers prefer to mount them on separate strips. In this case the cable is often terminated in a pot-head similar to that shown in Fig. 48, rubber insulated wires being connected to the paper ends of the cable and led out to the connecting strips;

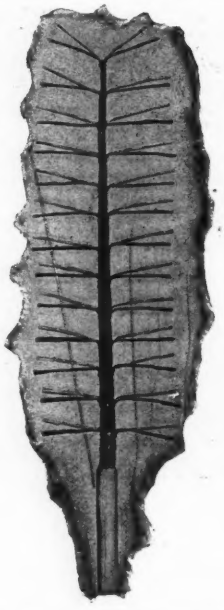


FIG. 47.—25-PAIR SPIDER FORM.

the sleeve is then filled with ozite and the end of the sleeve afterward battered together and tape wrapped around the wires at the top of the sleeve to keep them in place. These rubber insulated wires are brought to strips, placed either vertically or horizontally similar to that shown in Fig. 50, from which jumper wires are taken across the rack frame to the other side of the rack, to which they are attached to the proper protective devices which are mounted on vertical strips. There is one thing about Fig. 49, however, to which attention might be called, and that is that the figure shows a double row of strips to which wires can be attached. Where used as a simple terminal strip, only one row of these clips is used in the ordinary 100-pair cable and the strip made up accordingly. However, in the distribution of a 200-pair cable the strip might be used double as shown. It will also be noticed that in the figure one-half of the total length of this strip has been cut off in order to show detail more clearly. The clips in the example shown are mounted on a hard rubber strip on a wooden base. The cable wires are connected to one end of this clip and the jumper or cross-connecting wires to the other by soldering, which makes a reliable contact and prevents careless connections.

For cross-connecting or jumper wires construction men use rubber or silk insulated wire, in twisted pairs of different colors, as red and black, so that in this way the colors can be kept straight throughout the entire system.

Suppose, for example, that it should be agreed that the red color was to be the "sleeve" side of the line in all cases (and in central-battery systems this is important) the reds should be connected

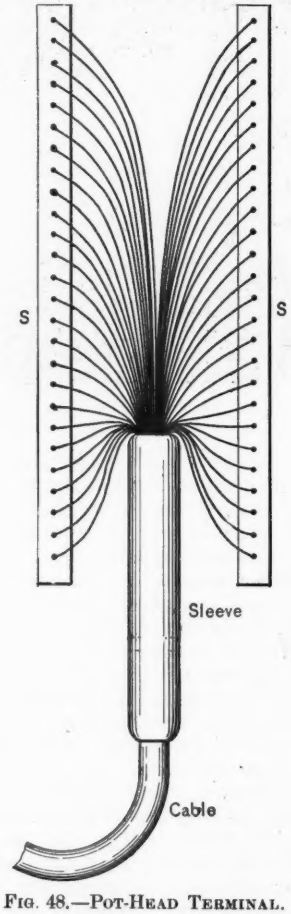


FIG. 48.—POT-HEAD TERMINAL.

together throughout the circuit as well as all the other circuits. Let the white color match with blue or black, if those colors happen to be on the other side, but there is nearly always a red wire in the

* Continued from the ELECTRICAL REVIEW for June 15, 1901.

kinds placed on the market, and in all cases keep the reds together.

STILL A LATER METHOD.

One of the more recent methods in vogue by one of the largest Bell licensees, and to a lesser extent by some of the independent companies, consists in splicing the outside cable about 30 feet back from the distributing board to a piece of what is known as "wool cable," because the insulation consists of woolen thread tightly wound on the wire. This woolen thread does not readily absorb dampness, and should water get in it will not carry it any great distance into the cable as cotton or paper would be sure to do. Besides this it will not carry fire should the wires in the cable become heated by means of a heavy current. Of course, as in the case of paper cables, the conductors are lead encased.

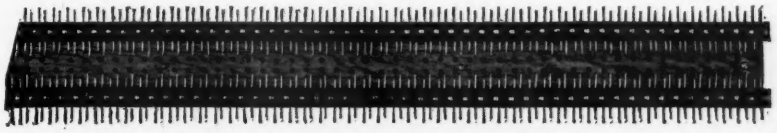


FIG. 49.—TERMINAL AND CROSS-CONNECTING STRIPS (HALF SECTION).

Independent construction men, however, can not procure this wool cable at the present time, owing to the fact that their opponents control the patents on it, and a substitute, which consists of one layer of silk and two of cotton, all wound in opposite directions around the conductor, takes its place. Sometimes two windings of silk and one of cotton are specified.

As silk possesses non-inflammable qualities, will not absorb dampness and does not seem to cost any more, there is no good reason why it should not be used. Where the splice is made, the joint is paraffined in the usual manner, and the new cable led to the distributing rack, formed up, waxed, shellaced and connected to the clips in the usual manner (Fig. 50). From the splice to the distributing rack the end of the cable should turn downward, if possible, in order to prevent water from running into it in case there should be a leaky roof or an open window when it rains. The wires of the cable are also generally wrapped with tape to the lead sheath, thus excluding the air as far as possible.

FIG. 50.—"FANNED OUT" CABLE TERMINAL.

In all the cable forms described above, where they are fanned out, a mixture of about equal parts of paraffin and beeswax should be used, as the paraffin alone is not hard enough to retain its place. In making the shellac for this work the gum should be cut with pure alcohol, if it is possible to obtain it, and it must be allowed to dry thoroughly before tests on the cable are made, but as it can not penetrate the paraffin to any great depth, it soon dries. Not long since a contemporary publication contained a letter from a gentleman in Iowa containing the following information about shellac for this kind of work:

"Take alcohol, one quart; gum shellac, six ounces. As all commercial alcohol contains a small quantity of water, put it in a wide-necked bottle, in which suspend strips of sheet gelatin. They will soften and swell, absorbing the water. When swelled, take out and put in other strips until the gelatin is not affected. You have now almost absolute alcohol, to which add the shellac. Keep corked and when dissolved it is ready for use.

"Hang up the strips of gelatin, when they will dry out and be ready for use again. The amount of shellac can be increased, but I prefer a thin varnish as it gives a neater appearance to the work and dries more quickly."

The advantages of these various methods, as said before, depend upon the size, location and conveniences of the exchange room. Thus, let us suppose we have an exchange that is never likely to exceed more than 300 lines. That being the case, the distributing board can be placed in a neat case alongside the switchboard, while the cable terminals can be placed against the wall and three or four short cables brought to the distributing rack and connections made permanent to one side of the clips.

In any case, however, the protective devices should not be omitted, as the danger from lightning or other high-tension currents must not be forgotten, and in order to obtain insurance against fire they *must* be installed. But even if not installed, it is worth a dollar a line to insure that additional safety against fire. In some parts of the country managers have been burnt out so completely that they had to replace their entire switchboards before they learned this lesson. One dollar a line for insurance against fire is not very much, considering that such a device will last a number of years, for there is no wear on the terminal, and the only expense is the replacing of fuses and wiping off carbons occasionally each summer. In the selection of fuse strips one thing should be borne in mind, namely, that the fuses should either be enclosed or placed in such a manner that in case they should melt they can not fall together.

To illustrate: Let us suppose we have a strip about four inches in width, with set screws at the side, and the fuse connection made with a piece of ordinary lead fuse wire. There is nothing to prevent these fuses, when ruptured by a trolley current—as at A, Fig. 51—from falling down and throwing current the whole length of the board as one fuse after another gives way, and this has actually happened more than once, when cables, board and, sometimes, the entire exchange burned out. Where economy has to be practised it might be suggested that the fuses mounted on mica strips will prevent that sort of thing, and they are cheap, too. Another thing about fuses is that they should not be mounted on fibre, as fibre has been known to absorb so much dampness as to render fuses of no avail.

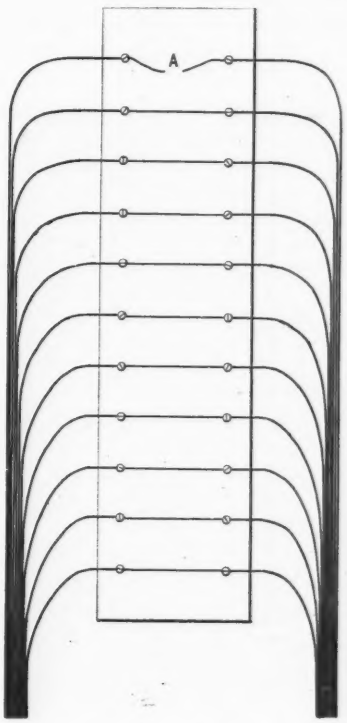


FIG. 51.—ORDINARY FUSE BOARD.

DECORATIVE ELECTRIC LIGHTING OF THE LOUISVILLE, KY., KNIGHTS TEMPLAR CONCLAVE.

BY G. WILBUR HUBLEY.

The electrical illumination of the streets and the festive lighting of the buildings at the twenty-eighth triennial conclave of the Knights Templar, held in Louisville, Ky., August 27 to 30, 1901, have surpassed all previous records of similar lighting.

Approximately 100,000 lamps were used in the general illumination, and the capacity of the electric lighting companies and the isolated plants was taxed to its utmost to supply this enormous demand; but all requirements were most creditably and satisfactorily fulfilled without flicker or interruption in service.

The general effect of the illuminated district was a most favorable impression of a scene from fairyland.

The distribution and diffusion of the lights being excellent, furnishing the illuminated section with a glow rather than a glare of light, as often is the case in electrical effects. Current was supplied by the Louisville Electric Light Company and the Citizens' Electric Lighting Company; also by isolated plants where their capacity was available.

The great success of the illumination and decorations was due largely to the untiring and indefatigable efforts and work of the chairman of the Conclave Committee, Mr. R. J. Brown. The general success of the conclave was remarked and it was admitted that the electrical illuminations proved to be the feature of attractiveness that surpassed all anticipation of the Knights Templar and the public in general.

The main feature of the display was the Triumphal Arch, erected at the intersection of Fourth avenue and Broadway. This arch was built under the direction of the architect, Chas. D. Mayer, of Louisville, and designed by the sculptor, M. J. Dover, of Chicago.

The base, formed of four massive columns, was 60 feet square and the quadruple arch was capped by a massive dome. At the apex of the dome, 95 feet above the street, a large cross and crown was arranged to revolve by means of power furnished to a 500-volt motor. The arch consisted of woodwork finished with mortar, the whole being painted white. Handsome and appropriate staff decorations of Maltese crosses and figures of knights on horseback added to the beauty of the arch.

The illumination was superb, 5,000 16-candle-power lamps being employed on this arch alone. The effect was a blaze of electricity approaching the grandeur of electrical illumination of the Pan-American Exposition.

The arch and its illumination were probably the most elaborate of any similar work ever attempted in this country, with the exception of the Dewey Arch, in New York city.

Fig. 1 shows a night view of the arch.

The Court of Honor, on Jefferson street, between Fifth and Sixth streets, consisted of 26 Corinthian columns, made of shafts of wood with covering of staff in artistic design. Each of these columns was 30 feet in height, and they were set from the grand stairway of the court-house, at a distance of 35 feet apart, on both sides of the street. The columns were decorated by ropes of laurel, and on top of each was a large vase filled with tropical plants. Along the columns were double garlands of laurel, and between these garlands of green, at every foot, was an eight-candle-power lamp.

The beautiful effect by day was even heightened by the brilliancy of the illumination by night. The colossal court-house, of Grecian architecture, with its massive stairway and columns, formed a fitting background for the Court of Honor.

The court house was outlined with 1,500 eight-candle-power lamps, and its decorations consisted of a 20-foot cross and crown illuminated by 300 lamps. This design was located at the head of the grand stairway between the columns, and on the east and west wings were 15-foot crosses of Salem, each lighted by 200 lamps.

The central section of the city was lighted by a number of arches spanning the streets. The district comprised about 10 miles of thoroughfare. These arches were in two general styles: The quadruple arches, of which there were 50, each having 160 sixteen-candle-power lamps, were located at the street intersections. They were arranged in festoons from the four curb corners of the street crossings to a common point, 35 feet over head. The single arches, of which there were 56, each having 80 sixteen-candle-power lamps, were arranged to span the streets at intermediate points between the street corners. At the apex of the single arches elaborate figures were suspended. These consisted of four different styles, representing appropriate symbolic designs, among them the cross of Salem, the passion cross, the Maltese cross and the cross and crown.

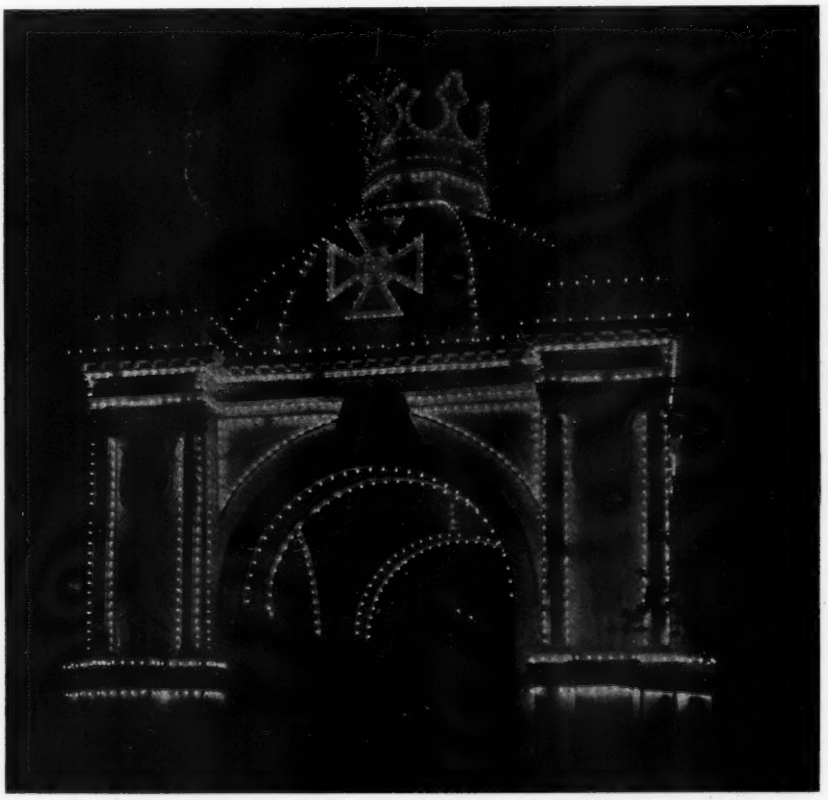


FIG. 1.—NIGHT VIEW OF THE TRIUMPHAL ARCH, LOUISVILLE, KY.

Forty of these centre-pieces, each being lighted by about 80 sixteen-candle-power lamps, were employed.

One of the illustrations shows a night view of the street illuminations by the quadruple and single arches and the suspended designs.

One of the most beautiful designs of the

whole display was an enormous Maltese cross, formed of 300 red lamps, and in its centre a cross and crown composed of 500 miniature lamps of variegated colors. This piece was located in the Horse Show Building, where the grand ball was given. The decorations and illuminations of the interior of this building were imposing, and in addition to the hundreds of incandescent lamps there were forty-six 2,000-candle-power arc lamps employed.

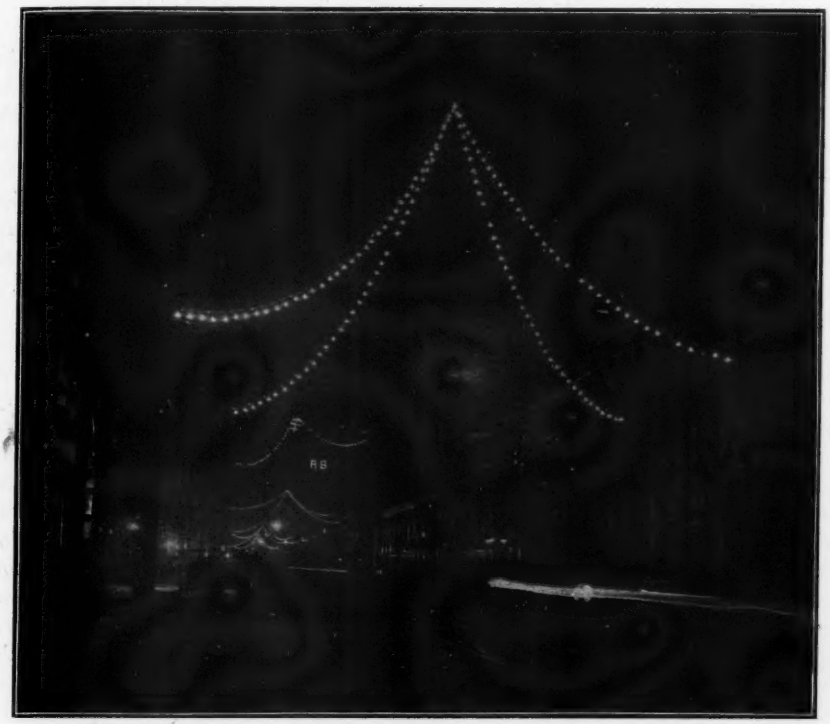


Fig. 2.—Street Illumination by Suspended Arches.

The general illumination of buildings and the many elaborate designs and signs along the principal thoroughfares added much to the extensive lighting by the Conclave Committee. The United States Custom House and all the city buildings were outlined by electric lamps, the city hall having 1,500 sixteen-candle-power lamps and the lights extending on every line of the building from its base to the top of the flagstaff on the tower, a height of 200 feet. In addition to these lights there were several designs on the front of the building. A Maltese cross, with cross and crown in its centre, formed of 360 lamps, was a very effective piece, and a passion cross, 20 feet in length and composed of 200 lamps, was very attractive.

The most noteworthy electric illumination of buildings was to be seen at the Louisville & Nashville Railroad office building. This consisted of an immense Maltese cross, formed of 700 sixteen-candle-power lamps and covering the entire space on front of the building. In the centre of the cross the life-size figure of a knight on horseback was formed of 1,200 miniature lamps in colors.

The illumination by the Frank Fehr Brewing Company was probably the most extensive of any private decoration. The large plant was fairly ablaze with electric lamps, and the face of the building showed

The *Courier-Journal* Building displayed a very attractive exhibition of electrical effects in plain and colored lamps, the building being outlined by 16-candle-power lamps, from its base to the cupola. Several symbolic figures, formed by electric lamps, were used, the most prominent and the feature of this illumination being the figure of a knight on horseback. Several novelties in lighting effects, such as can be obtained only by electricity, were interesting. One of these consisted in automatically switching on and off the lights on the flagstaff, which produced the effect, in the colored lamps, of a May-pole. A large clock, with the figures formed in miniature lamps which resembled jewels, was a very attractive design as well as a useful one, as the correct city time was indicated. Twenty-five hundred lamps were used in the illumination of this building. One of the illustrations shows a very clear night view of the *Courier-Journal* Building.

The sign "Columbia Building," using 600 sixteen-candle-power lamps, attracted much attention, as it was placed above the roof of this "sky-scraper" office building. The sign was 100 feet in length and each letter was six feet in height.

The Mutual Life Insurance Company of Kentucky had a most striking illumination, employing 1,500 sixteen-candle-power lamps on the building, also several designs representing Templar symbols.

Among the most artistic and novel electrical decorations was a huge fan on the front of the Equitable Building, being formed of 800 colored miniature lamps and so arranged by switching controller, operated by a motor, to automatically switch on and off the lamps in such manner as to produce the effect of opening and closing of the fan.

A clown juggling a barrel with his feet was another novel figure operated and illuminated by electricity which attracted considerable interest. The motions which were controlled by electric motors and the varying lighting effects of miniature lamps made the attraction worthy of note as a novel advertising medium.

A large anchor composed of 500 sixteen-candle-power lamps was the centre-piece of the illumination of Rufer's Hotel.

Several designs of the American flag, with the appearance of waving in the breeze, added to the various effects in illumination that can be accomplished only by the aid of electricity.

Probably the most artistic design in the illuminations was a large peacock on the

Fig. 3.—Illumination of the Courier-Journal Building.

building of McNairy's Café. This was formed with about 500 miniature lamps of perfectly blended colors that are natural to the feathers of this beautiful fowl. The design was truly a work of art.

The floriculture of the many beautiful lawns of the municipal grounds and the private residences in the city were illuminated by miniature lamps to harmonize with the vari-colored plants. This effect was most beautiful, and the beauty of Nature's flowers by daylight was even heightened by the aid of electricity at night.

The Galt House and Louisville Hotel and other principal hotels and buildings all employed electric lamps for their decorations at night, and the varied effects were most beautiful and interesting and proved beyond question the perfect adaptability of the incandescent lamp for service of illuminative and decorative effects.

News from Great Britain.

(From Our Special Correspondent.)

AT THE risk of wearying readers of the ELECTRICAL REVIEW, I venture to record the latest development in connection with the electrification of the Metropolitan steam railway. This is no less than the registration of the Metropolitan District Electric Traction Company, with a capital of some $5,000,000. The objects of the company were set forth in my last notes, and it only remains to call attention to a fact which should be of peculiar interest to Americans. No public issue of the capital is to be made, but out of the 27 subscribers no less than 26 hail from the United States, Mr. Yerkes taking pride of place with 16,800 shares. From a national point of view it is regrettable that the bulk of the necessary capital was not forthcoming from British speculators, and it seems only another instance of the manner in which such outside financiers, who have the courage of their own convictions, are permitted to invade this country without the semblance of an opposition to conquer. There is this much to be said, however, the weak-kneed policy hitherto adopted by the directors of the two underground railway companies in question has been sufficient to disgust any one interested in their undertaking, but in view of the almost phenomenal success of the few underground electric lines at present existing in the city of London, it is hard to understand why home speculators have not been found willing—nay, anxious—to see the project through, in spite of American or other influences. In contradistinction to this view, however, it would appear abundantly clear that but for the appearance of Mr. Yerkes and his cofinanciers on the scene, the electrification of London's underground "stink-hole," as it has been called, would hardly have been achieved on this side of the millennium. Under these circumstances, Londoners will, no doubt, ere long be thankful to Mr. Yerkes to a degree they would not be willing to admit.

The much discussed monorail high-speed electric line between Liverpool and Manchester is, to all intents and purposes, sanctioned, inasmuch as committees of both houses of Parliament have passed it and all that remains is for it to receive the royal assent. Mr. Behr ought to be a happy man, for the only addition to the original bill is the provision that the Board of Trade shall supervise all the construction work and also to have the power to request any experiments it may deem necessary, at the expense of the company. In view of the confident manner in which the project has been supported, this clause should not be an onerous one, and any doubtful Thomas may rest assured that the company is not likely to be allowed to commence operations until all controversial points in connection with its construction are decided once and for all. The granting of this bill has been solely due to the fact that the committees have been thoroughly satisfied as to the feasibility of the proposal, as is shown by a significant passage in the summing up of the chairman of the House of Commons committee. It is as follows: "There is no competition. If the monorail be started and succeeds up to, or nearly up to, the point claimed for it by the promoters, it will, of course, annex a good deal of the express passenger traffic of the existing lines in its neighborhood, just as the railway absorbed the express coach traffic, *and if it succeeds it will deserve to do this,* and doing it will benefit the public." Altogether, the passing of this bill is a landmark in parliamentary procedure from an electrical point of view.

The great engineering congress which is to be held in connection with the Glasgow Exhibition, during the first week in September, is being most enthusiastically supported, large numbers of engineers having intimated their intention to attend. Section IX (electrical engineering) has some interesting papers on its programme, among them being "The Relative Advantages of Three, Two and Single-Phase Systems of Feeding Low-Tension Networks," by Mr. M. B. Field; "The Protection of Trolley Wires," by Professor A. Jamieson, and "The Use of Electricity in the Propulsion of Road Vehicles," by A. R. Sennett.

The Rœntgen Society, which, at the opening of its last session, offered a gold medal for the most practical X-ray tube for general purposes, has made its award. The winning tube is that of Mr. C. H. F. Müller, of Germany, but which was entered as "Cox's Record Tube." It is priced at 18s. 6d. Twenty-eight entries were received for the competition, some of which showed good handwork in the glass blowing. Definition, photographic effect, penetration and price were the chief considerations, no less than 75 per cent failing in the definition test, and the highly scientific committee who have had the matter in hand wish to draw the attention of manufacturers to this defect.

Although the question of electrical communication between the shore and lightships and light vessels round the British coasts has been under the consideration of a departmental committee since 1899, the only definite information as yet available is that "negotiations are proceeding" between the government and Marconi's wireless telegraph company.

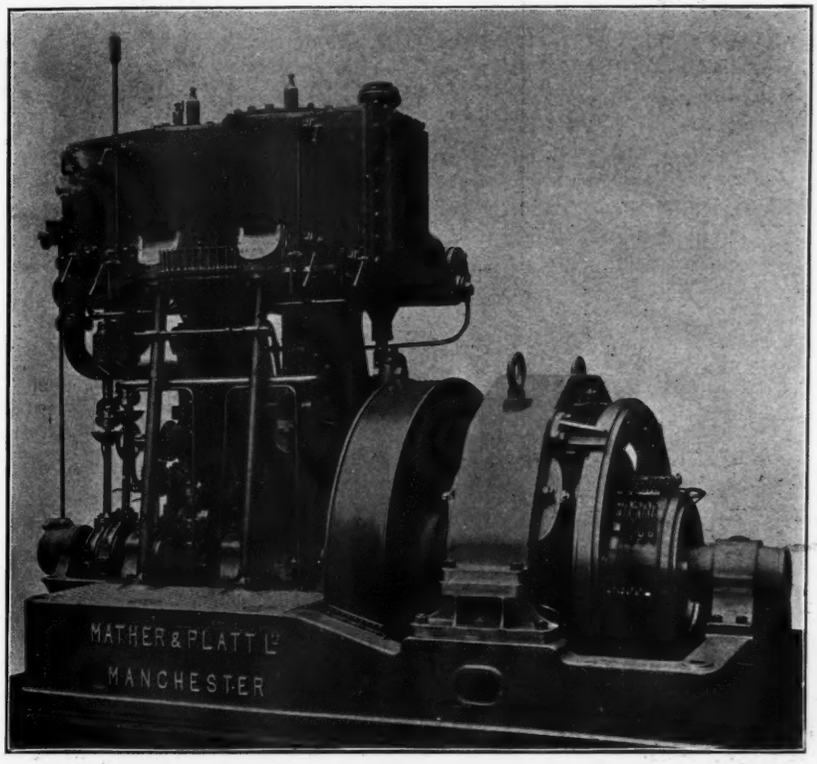
Much local rejoicing has recently taken place in connection with the first municipal telephone system in this country. This is at Tunbridge Wells, whose name became rather prominent early in the year when during the erection of their overhead wires many of them were brought to earth by a severe snow-storm. Competition has been quite exciting between the corporation and the National Telephone Company, with the result that a $32 service has been reduced to a $16 one by the company, as against about $23 by the local authority. Several novel features in the new service have been introduced by Mr. A. K. Bennett, who designed the exchange, one of which is that the operator can not overhear the conversations. Over 300 subscribers are connected and with judicious manipulation there is no reason why the system should not be perfectly successful. Apropos of this question of municipal competition with the National company the outcome of the Telegraph (telephonic communication) Act of 1899, several other corporations are busy constructing their exchange and networks. One of the largest, ultimately, will be at Glasgow, while other well-known towns include Brighton, Huddersfield, Portsmouth, etc. In addition to these many others are seriously considering the matter, and the result of all this should be greatly to the advantage of the subscriber in a few years' time.

Although none of the actual material of the all-British Pacific cable has yet been even manufactured, several of the cable houses are now being erected at the selected landing places. Landing places at Queensland, New Zealand and Norfolk Island (Vancouver) have been decided upon, and the route has been surveyed for 1,500 miles. The completion of the man-

ufacture of the cable is fixed for the end of 1902, and the engineers to the Pacific Cable board are satisfied that this period will not be exceeded. A manager has recently been advertised for.

A bill providing for the construction of a transporter bridge across the River Tyne, between South Shields and Tynemouth, was submitted to the government a short time ago and rejected. The idea was a new one to England, at any rate, the "bridge" or car being suspended from a trolley traveling on a girder, electrically-driven motors being on the car. As a matter of fact sanction has already been given for the construction of similar bridges across the Manchester Ship Canal and one or two other places, but in the present instance the ruling factor in its failure to secure sanction was the possibility of the target it would form to an enemy's fleet in case of invasion. In the event of it being destroyed and falling into the river it would form an effective barrier and thus prevent access to one of the most important places for refitting our own ships in time of war. Altogether, the committee's decision was a wise one.

The present London County Council is upholding its name for doing sensible things by deciding to send its electrical engineer and tramway manager to inspect the various systems of underground tramways in America, a curious action in the light of the stand which a predecessor took some years ago. In 1889 a proposal was made by a private company to construct such a subway in London, and was strongly supported by Sir William Preece and others, but the opposition of the London County Council itself succeeded in inducing the Parliamentary Committee to reject it. During the last few years, however, the congestion of London's traffic has made it abundantly evident that some such course is inevitable, bearing in mind that in the city itself the narrowness of the streets does not even permit of surface tramways. This action, on the part of London's most important governing body and the granting of £250 as expenses for the purpose, gives a clear indication of the wide differences of opinion existing ten years ago and at present. In addition, almost every week sees the buying of some portion of the horse tramways run by companies in greater London, all of which are to be converted to electric lines, and this great activity is giving much satisfaction as, indeed, it should.



MATHER & PLATT 215-HORSE-POWER GENERATING SET.

The accompanying photograph shows Messrs. Mather & Platt's contribution to the lighting and power supply for the Glasgow Exhibition. This set is capable of indicating up to 250 horse-power maximum continuous, or 215 horse-power normal working load. This represents an electrical output of about 650 amperes at 210 volts, or 750 amperes for short periods. The high and low-pressure cylinders of the engine are 14 inches and 24 inches diameter, respectively, both having a stroke of 16 inches. The high-pressure cylinder is fitted with double slide-valve gear, which is capable of variable expansion by hand while the engine is running. The governor is of the throttle type, driven by toothed gearing from the crank shaft. The speed of the engine is from 180 to 190 revolutions per minute. As I mentioned in some previous notes, this firm has by far the largest show in the Machinery Hall.

I have just learned that in connection with the arbitration which is to take place between the two "underground" steam lines on the question of the most suitable system to be adopted, Mr. Yerkes has retained Mr. Philip Dawson, a leading electric traction expert, on his behalf.

London, September 2. A. W.

Electric Traction in Buenos Aires.

A balance of profit amounting to £18,321 is shown by the report for the year 1900. It represents the profit of the traction company derived from the direct working of the lines of the La Capital Tramways Company, Limited. The Cordoba Light and Power Company's accounts show a balance of profit available for dividend amounting to £11,738 (of which £8,547 corresponds to the year 1900, the remainder being brought forward from 1899). As the traction company owns all but three per cent of the preference stock of the Cordoba company, and the full dividend on that stock requires £12,000, more than £11,000 of the balance stated above corresponds to the traction company's holding, which would make the total available for dividends up to £29,500. The balances of profit for 1900 have been arrived at after writing off from preliminary expenses and expenditure on supervision of construction and in connection with the purchase of materials required for construction, sums amounting to £3,031 from the traction company's earnings, and £486 from the earnings of the Cordoba company. The La Capital Tramways Company's accounts show a balance of profit brought forward from 1899 amounting to £13,528, which, with a sum of £515 realized from the horse renewal fund in 1900, makes a total of £14,043. The directors recommend the payment of the five per cent cumulative dividend (less tax) on the preferred shares from date of issue to September 30, 1900.

Some Overhead Tramrail Conveying Appliances.

The use of overhead trolley conveying apparatus is rapidly increasing in factories and other places where heavy weights have to be handled, and the manufacture of appliances for the purpose has grown to be an industry of no small dimensions. The accompanying illustrations show various features of the system developed by the Brown Hoisting Machinery Company, of Cleveland, Ohio. In Fig. 1 is shown a turntable whereby trolleys may be shifted from one track to another, while Figs. 2 and 3 show, respectively, single and double switches. The standard type of steel plate trolley used in connection with an I-beam as a rail is shown in Fig. 4, which exhibits also a double-hook hoist with triplex block. It will be noted that the diameter of the trolley-wheels is nearly as large as the depth of the I-beam, which allows larger wearing parts and reduces frictional resistance. The use of such large wheels is attainable only by the application of a special form of hanger bolt, which is also manufactured by the same company. The wheels of these trolleys are secured on steel pins revolving upon adjustable bearings giving an inside as well as outside support to the wheels. The bearings are self-oiling, and are equipped with proper receptacles for holding a six months' supply of lubricant.

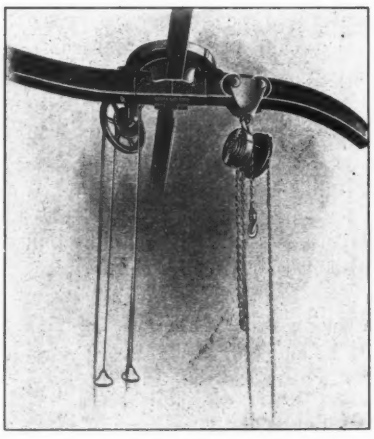


FIG. 1.—TROLLEY TURNTABLE.

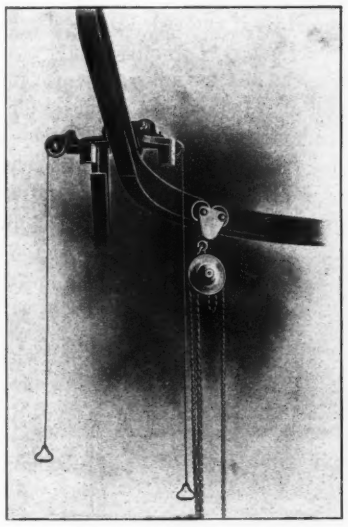


FIG. 2.—SINGLE SWITCH.

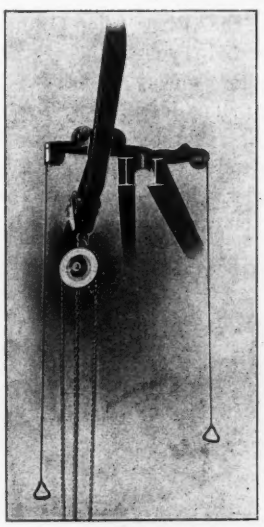


FIG. 3.—DOUBLE SWITCH.

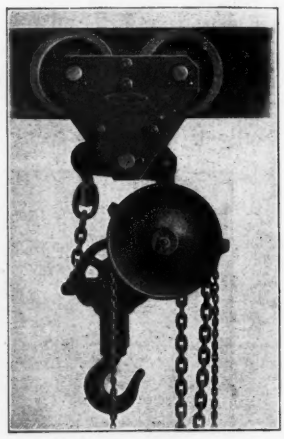


FIG. 4.—STEEL PLATE TROLLEY.

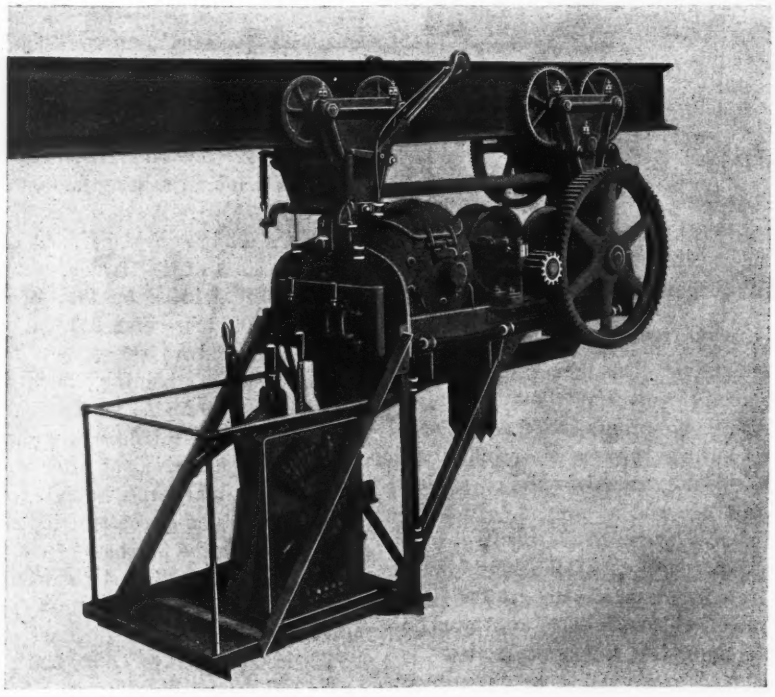


FIG. 5.—ELECTRIC POWER TROLLEY.

Fig. 5 shows an electric power trolley, which is built in sizes of from one ton to five tons capacity, the whole appliance being suspended from eight wheels, four of which run on each side of the flange of the I-beam, as shown. The machine is furnished with swiveling trucks, and the five-ton size will run around a 16-foot radius curve. An electric motor is provided for each motion of hoisting and trolleying, and the operator rides with the trolley, as the illustration well shows. The current is taken from overhead wires by means of two small under-running trolleys, and the appliance is geared for speeds of from 200 to 500 feet a minute horizontally, and from 10 to 50 feet a minute vertically. This appliance gives an excellent illustration of the extent to which special machinery for hoisting and transporting has been developed of recent years, and also shows an ingenious and interesting application of electricity, reflecting much credit upon its designers and manufacturers.

Electric Baths.

Dr. Armitage, an English physician, has used electric baths in the treatment of chronic lead poisoning, and in 40 severe cases 37 were benefited, some being completely cured. The rapid improvement is attributed to the change of the lead salts in the body into new and insoluble compounds The apparatus used consisted of a large porcelain bath tub, carefully insulated and provided with a large carbon negative electrode at the foot and a small movable carbon positive electrode, and a battery of 120 large Leclanché cells, connected in threes. The treatment began with the use of 84 to 120 cells, but at the close only 24 to 60 were needed. The patient was immersed for 15 or 20 minutes in the water in the tub, and the current was regulated by his sensations, the best results being obtained when the skin was reddened without causing actual pain.

Americans Enjoy an Automobile Tour in Europe.

Mr. Chas. J. Glidden, of Lowell, Mass., of the Erie Telephone Company, and Mrs. Glidden arrived on the Deutschland Thursday, August 29, from Cherbourg, having completed during part of the months of July and August a 2,000-mile drive on a 16-horse-power Napier autocar in England and France.

Mr. Glidden's Automobile Party at Ely, England.

The accompanying photograph was taken during the noon halt at Ely, England. The routes covered with various side trips were as follows:

England—London, Oxford, Stratford-on-Avon, Warwick, Leamington, Kenilworth, Coventry, Derby, Sheffield, Halifax, Leeds, York, Lincoln, Cambridge, Bedford, London, Folkestone, where the channel was crossed to Boulogne. France—Dieppe, Havre, Rouen, Paris, Fontainbleau, Rambouillet, Chartres, Orleans, Blois, Samur, Angers, Nantes, Vitre Vire, Fougers, Caen, Trouville, Etretat, to Dieppe, where the car was shipped across the channel to New Haven, thence driven to London.

The weather throughout the trip was delightful, only one day's delay on account of rain.

The roads were in perfect condition, equal to and even better than any of our best boulevards, and a speed from 25 to even 40 miles per hour could be easily maintained for long distances in France.

The pneumatic tires were in excellent condition at the end of the journey, and estimated good for at least 1,500 miles additional drive. Only three slight punctures occurred to the tires, which were quickly repaired by the mechanician.

An Electrical Engine Stop.

In the accompanying illustrations are shown two views of the Monarch engine stop, a contrivance used to stop steam engines when, through any accident, the latter tend to run away or whenever it is desirable from any cause to stop them from distant points. It is manufactured by the Monarch Manufacturing Company, of Waterbury, Ct. The "speed limit" shown in Fig. 1 is belted to a shaft or flywheel and is adjustable to any desired number of revolutions of the engine above normal. When speed increases to the point for which the apparatus is set the speed limit closes an electric contact operating the stop, shown in Fig. 2. This contrivance is geared to the engine in such a way that as soon as the electric connection is made it begins to operate and closes the throttle valve by means of the sprocket wheel at the right, which is geared through a chain to a similar wheel on the throttle-valve stem. A circuit for controlling the stop may be run about a works, for example, and should any accident happen to the belting or shafting, or any other reason require an immediate stopping of the mechanism, all that is necessary is to touch a button and the machine automatically does the rest.

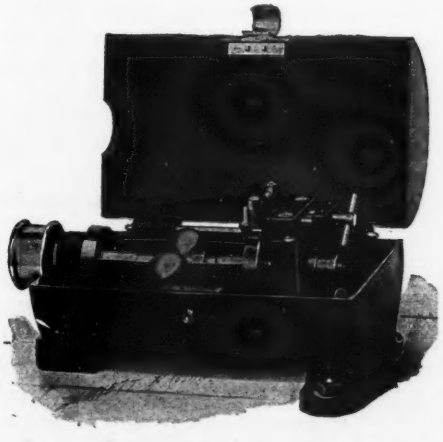


Fig. 1.—Automatic Engine Speed Limit.

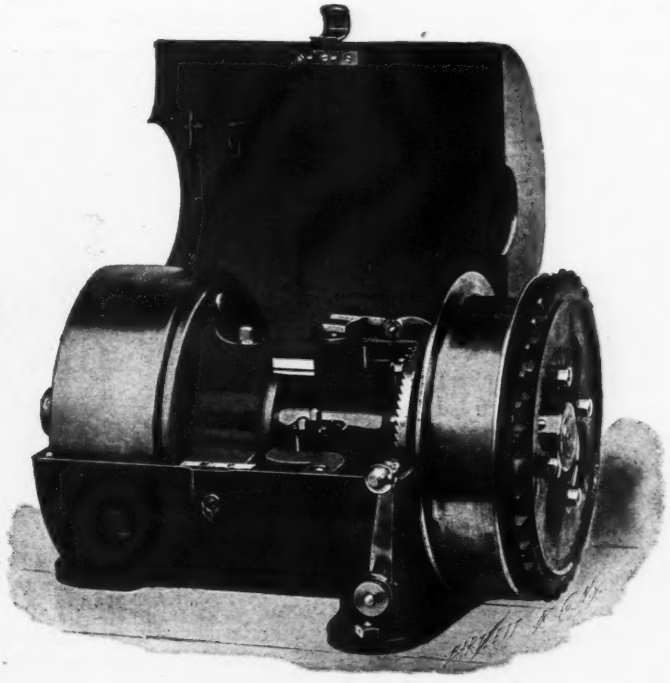


Fig. 2.—Automatic Electric Engine Stop.

THE MUNICIPAL ELECTRICIANS.

ELECTION OF OFFICERS AND CONCLUDING SESSIONS OF THE NIAGARA FALLS CONVENTION.

The annual convention of the International Association of Municipal Electricians, the early proceedings of which were reported quite fully in the ELECTRICAL REVIEW of last week, concluded its work at Niagara Falls on Thursday, September 5. The officers for the ensuing year were elected as follows:

President, H. S. Hatch, Detroit, Mich.

Vice-presidents, W. M. Petty, Rutherford, N. J.; A. C. Farrand, Atlantic City, N. J.; Wm. Crane, Erie, Pa.; W. A. Barnes, Bridgeport, Ct.

Secretary, F. P. Foster, Corning, N. J.

Treasurer, Adam Bosch, Newark, N. J.

Executive committee, W. H. Thompson, chairman, Richmond, Va.; M. W. Mead, Pittsburgh, Pa.; W. Brophy, Boston, Mass.; J. W. Aydon, Wilmington, Del.; F. G. Boyd, Baltimore, Md.; F. C. Mason, Brooklyn, N. Y.; W. Y. Ellett, Elmira, N. Y.; G. F. McDonald, Ottawa, Canada; M. G. Canfield, Grand Rapids, Mich.

A finance committee was appointed as follows:

M. J. Donohue, Niagara Falls, N. Y.; J. F. Zeluff, Paterson, N. J.; J. Murphy, Cleveland, Ohio; Elmer Loomis, Allegheny, Pa.; John Simons, Jr., Charleston, S. C.

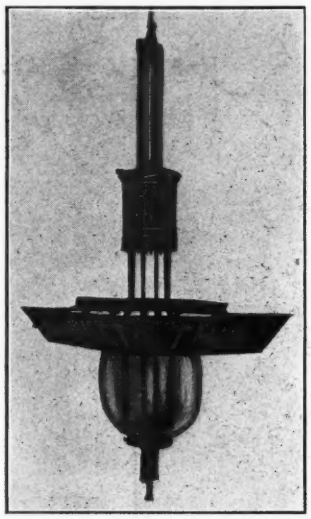
Mr. Frank C. Mason, of Brooklyn, N. Y., was especially honored by being made a life member.

On motion it was decided to hold the next meeting at Richmond, Va., and a vote of thanks was extended to the members of the press present and to the people of Niagara Falls for the many kindnesses shown the visitors.

Captain William Brophy, Boston, Mass., read his paper on "Inadvisability of Placing High and Low-Potential Wires Through the Same Series of Conduits or Through the Same Manholes." He related the various difficulties which had lead the telephone companies to place their wires underground in many cities. All companies should be permitted to put their wires underground.

Cities ought not to charge for franchises to do this as the companies have to pay a tax on their lines. Special taxes should not be laid on lines, as many people believe. Separate conduits for high and low-potential wires should be provided. Municipal ownership of such lines is bad, because the professional politicians do not look after best interests of people.

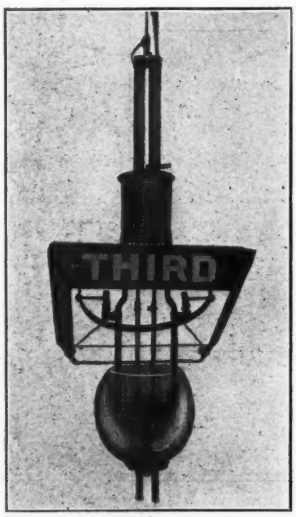
The author could find no benefits to be derived from municipal ownership of conduits. No public work can be undertaken and completed by a city anywhere nearly as cheaply as by a private corporation.



ARC LAMP STREET SIGN.

Hence conduits should not be built by cities.

If municipal ownership is decided on, the plan is to build one conduit for wires of high and low potential. Perfect insulation can not be maintained in such conduits. If any high-tension cables break their insulation all the other cables



ARC LAMP STREET SIGN IN POSITION FOR TRIMMING.

are rendered useless by the resulting fire. Economy of space and the revenues accruing from such conduits are the only reasons for the building of municipal conduits, but this is in no way justified as has before been shown. Captain Brophy then enumerated a number of instances in which a large amount of damage had been done to all the cables in conduits by the destruction of the installation of a high-tension cable. It is the duty of all having police and fire-alarm wires to exert themselves to the utmost to prevent them being placed in conduits with high-potential wires.

In the discussion Mr. Schurig advocated the separating of the conduit into two ducts, one for high and one for low-potential wires with fire-wall material between. Captain Brophy said you could really make no such separation, and that there is no known material for a fire-wall which would not melt. Some new form of insulation which would last for years was the greatest need in the electrical field.

Secretary Foster, in the absence of Mr. J. W. Aydon, read his paper on "Storage Battery and Controlling Board."

After a short discussion of Mr. Aydon's paper Secretary Foster read Mr. Tront's paper on "Need and Value of a Set of Rules for Outside Construction."

Mr. P. H. Alexander read a paper on "Electric Carbons."

Dr. Niles, of the Magneto Signal Company, of New York, described the fire-alarm magneto system of his company.

All present witnessed a very successful exhibition of "Kilfyre" in extinguishing a large fire which had been built in front of the hotel.

A New Type of Arc Lamp Street Signs.

The accompanying illustrations show a new variety of street signs for attachment to arc lamps. One of these signs has recently been put up at the corner of Barclay street and Broadway, in New York city. The construction of the sign and the method by which it can be tipped to permit the trimming of the lamp are easily visible from the illustrations. The weight of the sign is about three pounds. The letters are blocked out of milk glass and are therefore easily legible both by night and by day, the sign being readable at a distance of 200 feet from the lamp at night. The signs are being introduced by Mr. C. S. Knight, of Fort Wayne, Ind.

The Buffalo-Erie 100-Mile Automobile Race.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

The consents from the local municipalities having been obtained by the Pan-American authorities for the holding of the 100-mile road race between Buffalo and Erie, the governors of the Automobile Club of America have decided to hold the annual sweepstakes over that course on September 19, 1901, as originally planned.

The governors have also decided to hold the week of sports in the Stadium during the week September 16 to 21 inclusive, including the race for the mile record.

S. M. BUTLER, Secretary.

New York, September 3.

THE ASSAULT ON THE PRESIDENT.

It is impossible to add a stronger expression to the universal outpouring of sympathy which has followed the murderous attack upon President McKinley at the Pan-American Exposition on Friday of last week. The only bright side to this terrible calamity is the increasing hope that is felt, at the time this edition goes to press, of the President's recovery and the certainty that he is receiving every attention that skill and science can render.

An elaborate outfit of X-ray apparatus was hurriedly shipped on Saturday from Mr. Edison's laboratory, and at the time of writing is in working order in Buffalo ready for use should the surgeons decide to avail themselves of it. This apparatus was hastily assembled, all of the resources of the laboratory having been concentrated upon its quick completion, and was on its way to Buffalo a few hours after it was requested by telephone. It is not believed at present that there will be any attempt made, for some time at least, to extract the bullet which is now in the President's body.

The effect of the outrage upon the general business conditions of the country has been and probably will be much less than if the assassin had been moved by any political or other intelligible motive. The country being in a state of profound peace and great general prosperity there is no feeling of alarm or concern as to general conditions and nothing to distract the public attention from sympathy with the sufferings of the President and his family. It is believed, however, that the effect of the attempted assassination will be to further the immediate passage of stringent laws regarding anarchists and the other murderous offscouring of European populations that have abused every privilege that this country offers them. No American in the face of this profound calamity can fail to feel most intensely two sentiments—one of sympathy with the wounded President, and the other of vigorous determination to rid the country at any cost of the people who can conceive and execute such atrocities.

Association of Edison Illuminating Companies.

Seventeenth Annual Meeting of the Association of Edison Illuminating Companies at the Pan-American Exposition, September 10, 11 and 12.

THE SEVENTEENTH annual meeting—the twenty-second convention—of the Association of Edison Illuminating Companies was held in the meeting room of the New York State Building on the grounds of the Pan-American Exposition, at Buffalo, Tuesday, Wednesday and Thursday, September 10, 11 and 12.

This association represents the moving spirits in the various central station enterprises known under the general name of Edison Illuminating Companies and distributed through a considerable number of American cities. The association is an outgrowth of the feeling of comity of interest which has naturally prevailed among those who have carried to its tremendous present extension the idea which, germinating in the mind of Mr. Edison nearly 20 years ago, first took shape in the old Pearl Street Station in New York. There have been many changes and great ones since the first distribution of electricity from central stations for commercial lighting and power purposes upon the old low-tension two-wire system. The engineers and men of affairs who have conducted the various Edison companies from those days to the present have not only witnessed the growth of the electric lighting industry from its humble beginnings to its present great importance, but they have, perhaps, more largely than any other one group of similar men, been responsible for the increase and enlargement of the industry. It is a far cry from the Pearl Street Station to the 100,000-horsepower generating plants of to-day with their complex system of polyphase machines and high-tension distribution.

For 17 years the various leading spirits of the widely scattered Edison companies have met, annually at least and sometimes oftener, to hold "experience meetings," at which they interchange ideas and data, read papers, renew their acquaintances, and in general enjoy the advantages of association. For some time past the association has maintained standing committees on such subjects as meters, incandescent lamps and the encouragement of the electric automobile as an adjunct to central station practice. Naturally, on account of the comparative age and great importance of the various Edison illuminating companies, their representatives stand for important and well-established organizations allied with the central station industry. For all of these reasons the meeting is always one of importance, and it was particularly so on the occasion of the meeting in Buffalo on account of the interest and value of the various papers that were presented, dealing with a large number of central station problems and matters of interest.

It must be an extraordinary gratification for an engineer to live to see the complete fruition of his ideas as Mr. Edison has in the case of the central station. There can be no doubt, either in his mind or in that of others interested in electricity, that far the greatest invention he has ever made, and perhaps the greatest in the whole range of electrical engineering, is that of the central station. The idea of supplying electricity over extended areas from a central point, and the method whereby it was done commercially, were evolved by him, and the companies represented in this association are the outcome in part only of this protean idea.

The meetings of this association are exclusively for the benefit of its members, the public not being admitted to the sessions. A report, however, of the proceedings is given to the technical press. At this meeting the overshadowing effect of the attempted assassination of President McKinley, which occurred within a few hundred yards of the meeting hall, was keenly felt, and the anxiety felt by all classes of citizens was naturally shared by those in attendance.

The programme as arranged was as follows:

"Modern Electric Light Accounting," by A. S. Knight, Edison Electric Illuminating Company, Boston.

"Competition with Isolated Plants," by John F. Gilchrist, Chicago Edison Company, Chicago.

"On the Selection of a Cable for a Given Service," by Wallace Clark, Schenectady.

"The Evolution of Exposition Lighting," by Luther Stieringer, New York.

"Some Notes on a Short European Visit," by Arthur Williams, New York Edison Company, New York.

"Timely Lamp Topics," by F. W. Willcox, Harrison, N. J.

"Spherical Candle-Power of Incandescent Lamps," by Clayton H. Sharp, test officer Lamp Testing Bureau.

"Progress in Electric Switch Design," by Caryl D. Haskins, Schenectady.

The first day's session was called to order by President John W. Lieb, Jr., of the New York Edison Company, a large attendance being present, the meeting being held in the New York State Building on the Pan-American Exposition grounds.

The address of President Lieb and routine opening business followed. There were about 100 present at the opening.

Mr. Luther Stieringer was appointed sergeant-at-arms. Mr. Stieringer's paper on the electric lighting of the exposition was read by Mr. Arthur Williams. Papers on incandescent lamps followed and were discussed.

The programme as announced above was carried out, with some slight changes each day. Abstracts of papers and discussions as furnished by the Publishing Committee of the association will appear in later issues of the ELECTRICAL REVIEW.

Tuesday evening the visitors remained on the grounds of the exposition to witness the superb lighting effects, and all were delighted. It was a magnificent presentation of their own handiwork, for nearly every one present had directly or indirectly contributed to this most beautiful result.

On Wednesday Dr. A. E. Kennelly's favorable report on the development of the Edison storage battery was listened to with much interest and greatly applauded.

Wednesday afternoon the entire party were taken to Niagara Falls, and traveled over the Gorge road and along the Canadian side. The trip was a new one to many and was greatly enjoyed.

On Thursday Mr. L. A. Ferguson, of the Chicago Edison Company, was nominated for president, and later was elected.

Thursday evening, at seven o'clock—as this issue of the ELECTRICAL REVIEW goes to press—the ladies and gentlemen attending the convention are one and all the guests of Mr. Charles R. Huntley, general manager of the Buffalo General Electric Company, at a banquet given at Alt Nuernberg, on the exposition grounds. Mr. Huntley has been most attentive to the visitors, and this enjoyable banquet promises to be a fitting climax to a week of pleasant instruction and entertainment.

The attendance is the largest since the association was formed, and a large number of ladies are present. New York is well represented. Among others are Messrs. Thomas E. Murray, J. W. Lieb, Calvin W. Rice, Arthur Williams, of the New York Edison Company. Others present, including a large delegation from the Schenectady offices of the General Electric Company, are the following: Mr. Samuel Insull and Mr. L. A. Ferguson, of Chicago; Henry L. Doherty, of Denver; Mr. Fred N. Kimball, of Boston; Mr. B. E. Sunny, of Chicago; Mr. Alex. Dow, of Detroit; Mr. John W. Howell and Mr. Wilson Howell, of Harrison, N. J.; Mr. W. S. Barstow, of Brooklyn; Mr. E. H. Mullin and Mr. Charles T. Hughes, of New York; Mr. Henry W. Darling, of Schenectady; Mr. A. S. Knight, of Boston.

Dr. W. M. Habirshaw, of New York, was in attendance and possesses a wide acquaintance among the gentlemen of the association.

Mr. Luther Stieringer has presented to every visitor a night photograph of the lighted electric tower—a very popular souvenir.

Street Railway Men of New York.

Annual Convention at Rochester of the Street Railway Association of This State.

THE nineteenth annual meeting of the New York State Street Railway Association was held at Rochester, N. Y., September 10 and 11 of this week. The attendance was representative, and it was composed of many of the leading men identified with electric traction of the Empire State.

The officers of this association during the year just closed were the following-named gentlemen, nearly all of whom were in attendance:

President, Mr. G. Tracy Rogers, of Binghamton, N. Y., president of the Binghamton Railroad Company; first vice-president, Mr. John Boyle, Utica, N. Y., president of the Utica Belt Line Street Railway Company; second vice-president, Mr. E. G. Connette, Syracuse, N. Y., vice-president and general manager of the Syracuse Rapid Transit Railway Company; secretary and treasurer, Mr. Henry A. Robinson, New York city, solicitor of the Metropolitan Street Railway Company.

The executive committee is composed as follows: Chairman, Mr. H. H. Vreeland, New York; T. J. Nicholl, Rochester; W. Caryl Ely, Buffalo; Clinton L. Rossiter, Brooklyn.

The first day's session was devoted exclusively to the programme as published in the ELECTRICAL REVIEW of August 31, the report of which follows. Much interest was shown in the proceedings and the discussion was of a practical and earnest nature. The annual banquet Tuesday evening was well attended and partook of the nature of an old-time reunion. The attendance of representatives of manufacturing and supply companies was quite noticeable and was largely the result of upward of 600 invitations that had been sent out requesting their presence and to bring such exhibits as they might choose to make. President Rogers and his associates are certainly to be congratulated over the success that has attended their efforts in making the New York State Railway Association the excellent organization it has become.

There was much interest expressed by many persons in attendance in the convention of the American Street Railway Association—the national organization—which is to be held in New York city early next month. Probably all of those in attendance at the Rochester convention will be present in New York city.

The meetings and exhibition were held in Fitzhugh Hall, elaborately decorated with flags. The entire hall was filled with exhibits, these being more numerous and more extensive than ever before in the history of the state association.

All the sessions were held in the gallery of the hall, President Rogers in the chair, with Secretary Robinson as his right bower.

President Rogers's annual address first alluded, in fitting terms, to the attempted assassination of President McKinley, and then reviewed at some length the rapid advances that were being made in electric traction. The success of interurban lines and improved equipment was noted, as well as the unfairness of the law taxing street railroads one per cent on gross earnings, while one-half of one per cent is the tax on other corporations. Mr. Rogers stated that the street railroads of this state had carried over one billion passengers during the past year, the net earnings being the same as the year previous —$0.0155.

At the conclusion of this address resolutions condemning the murderous attack on the President were adopted.

Treasurer Robinson announced that the association had $2,717.17 in its treasury.

An invitation from the Rochester Telephone Company to visit its new exchange was received with thanks.

Two excellent papers on "Track Bonding" and "Accidents" were read.

Mr. Maurice Hoopes read an interesting paper on "The Third Rail," favoring the system and describing its use by the New York, New Haven & Hartford Railroad, and by the Albany & Hudson Railroad. He stated that the comparative cost was in favor of the third rail as against the trolley. In response to inquiries he stated that these two companies had experienced scarcely any difficulty from snow on the track, as it was easily removed, but sleet had on a few occasions caused some annoyance.

A valuable contribution from a thoroughly practical man was the paper on "Storage Batteries," by Mr. Franklin E. Morse, of Brooklyn, superintendent of power of the Brooklyn Heights Railroad Company. Mr. Morse had found the storage battery, which was of the chloride type, of great assistance in economically taking care of the peak of the load during hours of heavy traffic, and there was no

noticeable deterioration in it. He is using three installations at different points with great success, one of them being housed in old cars to be hauled to other points as needed. Mr. Vreeland and Mr. Ely gave similar testimony of the excellent use they had found for storage batteries, the former stating he had met with gratifying success in applying the battery current to keeping up the voltage when a bad load of coal or other cause had compelled it to fall with cars on 15 seconds headway and every volt precious.

Numerous other papers were read and discussed, the meeting proving to be in point of interest, attendance and extent of exhibits the banner one of the association.

In addition to the officers and speakers named above there were in attendance, among others, the following-named gentlemen: Major H. C. Evans, H. M. Littell, Joseph R. Ellicott, J. C. Barr, H. S. Cooper, of New York; general manager W. W. Wheatly, of the Brooklyn Rapid Transit Company; Mr. G. W. Swan, of John A. Roebling's Sons Company, of New York; Mr. J. S. Speer, of the Speer Carbon Company; Colonel Ashley W. Cole, president of the State Railroad Commission, and Mr. Charles Barnes, electrical engineer of the commission. The street railroad men fairly represented the traction interest in all parts of the state.

Among the exhibitors were the following companies, and all had neatly and attractively arranged exhibits. Peerless Rubber Manufacturing Company, Lord's Compounds, Lorain Steel Company, Electric Storage Battery Company, Taylor Electric Truck Company, Gold Car Heating Company, Sterling Lubricator Company, Hole & Kilburn Company, Weber Rail Joint Manufacturing Company.

Mr. T. J. Nicholl, of Rochester, was greatly praised for the successful and enjoyable meeting and the handsome provisions made.

A fine programme of entertainment was provided for the ladies in attendance, including visits to the Genessee Falls and Ontario Beach. The banquet, Tuesday evening, was given at Ontario Beach.

On Wednesday officers were elected as follows: President, G. Tracy Rogers, of Binghamton; first vice-president, E. G. Conwette, Syracuse; second vice-president, Addison B. Colvin, Glens Falls; secretary and treasurer, Henry A. Robinson, New York city; executive committee—the president, and Messrs. H. H. Vreeland, W. Caryl Ely, T. J. Nicholl and J. L. Greatsinger.

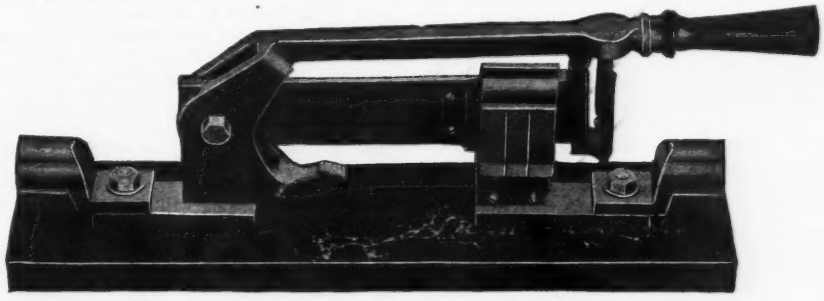
AMERICAN STREET RAILWAY ASSOCIATION.

A VERY COMPLETE EXHIBIT AND LARGE ATTENDANCE ASSURED FOR THE OCTOBER MEETING IN NEW YORK.

The twentieth annual convention of the American Street Railway Association will be held in Madison Square Garden, New York city, Wednesday, Thursday and Friday, October 9, 10 and 11. Secretary T. C. Penington informs the ELECTRICAL REVIEW that papers on the following subjects will be presented:

"Street Railways: A Review of the Past and a Forecast of the Future."

"The Adoption of Electric Signals on Suburban and Interurban Railways, Single or Double Track, and Their Economy of Operation."



A NEW QUICK-BREAK SWITCH.

"The Value of Storage Batteries as Auxiliaries to Power Plants."

"The Public, the Operator and the Company."

"The Best Manner and Mode of Conducting the Return Circuit to the Power-House."

"The American Street Railway Association: The Purposes of Its Organization and the Benefits Accruing to Investors in and Operators of Street Railway Properties by Membership Therein."

"The Economies Resulting from the Use of Four Motors Instead of Two on Double-Motor Equipments."

"The Best Form of Car for City Service: A Consideration of the Various Types of Car as to Size of Car and Arrangement of Seats, Including Best Types of Brakes and Wheels."

"Practical Results Obtained from Three-Phase Transmission and Rotary Transformers or Motor-Generators in Transmitting Power on Railway Lines."

"Relations of Interurban and City Railways."

"The Modern Power-House, Including the Use of Cooling Towers for Condensing Purposes."

Every foot of space in Madison Square Garden has been secured for exhibition purposes by manufacturers and others, and Thursday, October 10, has been set apart as a day for the examination of exhibits, no session being held on that day. The annual banquet will be held on Friday evening, October 11, and the headquarters of the association will be at the Murray Hill Hotel. A rate of one and one-third fare for the round trip, on the certificate plan, has been granted.

A number of committees have been appointed, composed of gentlemen of New York and vicinity prominent in electrical circles. Among these committeemen are: Messrs. H. H. Vreeland, A. M. Young, E. P. Bryan, Eugene Griffin, B. H. Warren, Frank J. Sprague, Henry L. Shippy, James H. McGraw, Alfred Skitt, H. C. Evans, Thomas C. Wood, Chas. W. Price, Frank MacGovern, John T. McRoy, W. L. Candee, St. Clair McKelway, E. H. Mullin, Edward A. Mahar and Colonel N. H. Heft.

Mr. Marcus Nathan is the director of exhibits, and his address is the Grand Central Palace, Forty-fourth street and Lexington avenue, New York. All exhibits should be addressed to "Exhibitor, care Madison Square Garden, New York," and delivered to that point not later than Saturday morning, October 5.

A New Quick-Break Switch.

A quick-break switch, made by Messrs. Zimdars & Hunt, New York, is shown in the accompanying illustration. It is claimed to be a strictly high-grade switch, one that will meet the severe service to which this type of switch is so often subjected.

The cut shows the principal features of the design. The handle lever is connected with the blade by spiral springs. In the act of opening, these springs are fully elongated before the blade moves, but at that moment the blade is started by the finger on the lower end of the handle lever, and then, under the action of the springs, flies out instantly and an instantaneous break is effected. There is no arcing at the main contacts, however, this being taken care of by auxiliary carbon contact blocks, which are supplied on all these switches. The switch shows evidence of careful designing, and the manufacturers state that, owing to the liberal contact and sectional areas provided, there is no possibility of undue heating even under a considerable overload.

Current Electrical News

COMMERCIAL NEWS

DOMESTIC AND EXPORT

It is announced that the control of the Kensington Electric Light Company, of Philadelphia, has passed into the hands of the Philadelphia Electric Company.

It is proposed to furnish electrical power from the River Tirso for the purpose of operating all the Sardinia mines, which are very numerous and important. The Tirso is the largest river on the island.

A report that negotiations looking to consolidation of the Philadelphia Traction Company, of Philadelphia, Pa., and the Pittsburgh Consolidation Traction Company are nearing completion has been put in circulation.

It will soon be possible to go by trolley from the Battery to Poughkeepsie, N. Y., and perhaps to Albany. Lines already connect Peekskill, Ossining and Tarrytown. It is said that plans for connecting Peekskill with Fishkill are under way.

Mr. Frank Trumbull, president of the Colorado & Southern Railway Company, states that the directors are considering the application of electricity to the company's suburban lines near Denver, Col., and have employed experts to make investigations.

News comes that Mr. Charles T. Yerkes has secured control of the projected Brompton-Piccadilly Tube Railroad, in London, which has a capital of £2,100,000. The road is to be worked in conjunction with Mr. Yerkes's Charing Cross-Hampstead line and the district railway.

It is reported that Mr. Charles W. Morse, a director in the Garfield National Bank and the Bank of New Amsterdam, New York, has made a proposition to the board of directors of the Telephone, Telegraph and Cable Company of America to purchase that corporation for $2,000,000 in cash.

The Singapore Tramways, Limited, is the title of a company which has just been organized in London under the British Limited Liability Acts. The main purpose of the company is to introduce electric traction into the Straits Settlements. The enterprise has a nominal capital of $10,000.

A deal for the Windsor & Amherstburg Electric Railway and the People's Electric Light Plant, of Windsor, Ontario, has been closed by the Everett-Moore Syndicate. The purchase price is $591,000, $21,000 cash having been paid to bind the bargain. The purchase was negotiated by Mr. J. C. Hutchinson, vice-president of the Detroit United Railway.

An exposition which is styled the Twentieth Century Electrical Exposition will be opened at the Royal Aquarium, Westminster, London, S. W., December 16, for a period of six weeks. According to latest London advices, the Ingersoll-Sergeant Drill Company is the only American firm so far which has secured space for the exhibition of its specialties there.

The Mexican Mining and Development Company, of Mexico, is reported to have sold the large waterfall known as San-Simonita, which is situated near Toluca, in the state of Mexico, to Mr. Alexander Potter, of New York city. It is said that Mr. Potter intends to generate electricity from the water power for the purpose of supplying Toluca, which has a population of about 14,000, with light and power.

President James J. Hill, of the Great Northern Railroad, who has been experimenting with electric motors for more than a year, believes that he has found something practical for hauling railway trains. He has ordered that electric motors supersede steam locomotives on the Cascade division of the Great Northern. If this change works satisfactorily, electric motors will be introduced upon other divisions of the Great Northern system.

Representatives of four large independent telephone systems covering all that part of the city north and west of Topeka, Kan., have organized the Kansas Union Telephone Company, with a capital stock of $100,000. Eight hundred miles of toll lines are represented, giving connection with over 200 towns. Topeka will be the central point for the big system. Work will soon be commenced on a through double metallic circuit from Topeka to Salina.

A new street-car line which is to be operated by electrical motive power is to be constructed in Monterey, Mexico. An application for a charter and concession is said to have been filed with the Mexican Secretary of State, and when granted it is anticipated that active work will be begun within a month or six weeks. Those interested in the project are American and Mexican capitalists, but the former will probably have the management of the enterprise.

Messrs. Stone & Webster, electrical engineers of Boston, whose interests in Seattle electrical companies are said to aggregate $7,000,000, and who financed the Snoqualmie Falls scheme which supplies all the power for Seattle and Tacoma and subsequently operated it, have taken over the Stave Lake power proposition in British Columbia. The Stave Lake Falls are 38 miles from Vancouver. The actual cost of establishing the plant is said to be about $500,000.

It is stated that the Russian Ministry of Ways and Communication has appointed a special commission for the purpose of discussing the project suggested by a syndicate of foreign capitalists to install a system of electrical towage on the Ladoga Canal. The syndicate's plans include the erection of works which will not only supply the necessary energy for towing purposes and for lighting the canal, but which will be capable of supplying manufacturers and St. Petersburg itself with electrical power.

The property of the Hartford Light and Power Company has passed into the hands of the Hartford Electric Light Company. After October 1 the first-named company will cease to be a corporation. The outstanding obligations of the light and power company at the time of the arrangement made with the Hartford Electric Light Company consisted of its capital stock, a first mortgage of $150,000, a second mortgage of $60,000, and claims against the company amounting to $644.80. The claims against the company have been taken care of except the first and second mortgages.

A new car barn for the Brooklyn Heights Railroad Company, of Brooklyn, N. Y., is being erected to take the place of the one destroyed by fire. The proposed building will have no roof over the yard where the cars will be kept, fence wall being the only means of enclosure. It is maintained that the cars being built to withstand all sorts of weather will suffer no injury by being stored in the open. The yard will be 200 feet wide and 775 feet deep. The walls will be of red brick trimmed with axe-finished blue stone. The contract has been awarded to the Eastern Construction Company, which is pushing the work vigorously and expects to have it completed by December 1.

ELECTRIC LIGHTING

The contract to put in the electric lighting plant in Conway, Mass., has been taken by Woodard Brothers.

It is rumored that the town of Jamaica, Vt., is contemplating putting in an electric light plant.

The United Electric Light Company, of Springfield, Mass., has purchased a lot on which it proposes to build a new electric light plant.

The United Illuminating Company, of Milford, Ct., is preparing to extend its system, according to reports. Mr. C. A. Paul is the superintendent of the company.

Work will soon be begun upon the construction of the electric power plant in Calumet, Mich., the excavations for the foundation having now been completed.

An electric power company was recently formed in Marshfield, Vt., by Dr. H. S. Parver, Messrs. J. W. Mears, M. E. Beckley. They are now preparing to build a plant.

At a special village election held in Holly, N. Y., the trustees were authorized to raise $15,000 and construct an electric light plant which is to be owned and operated by the village.

An application for 50,000 cubic feet of water of the Snake River at Rocky Point, for a power plant to cost $25,000, has been filed by Messrs. R. C. McKinney, J. S. Stack and G. F. Smith, in Weiser, Ida.

A 10-story power plant is to be erected by the Power Building Company in Cincinnati, Ohio. The bids are now being advertised for. This building, it is claimed, will be the largest power plant of its kind in the country.

The annual meeting of the Imperial Electric Light Company was held in Montreal and a dividend of seven per cent declared. The following officers were elected: President, V. Morin; vice-president, Rod. Tourville; treasurer, Dr. Chagnon; managing director, Mr. Chapleau.

The Huntsville Railway, Light and Power Company, of Huntsville, Tenn., has purchased the plant and entire outfit of the Stegall Electric Light Company, of Tullahoma. It will at once remove it to Huntsville, where it will be used in the repairs being made on the plant.

The stock of the Lewiston, Me., & Auburn Electric Light Company has been purchased by Mr. E. W. Gross, owner of the American Light and Power Company, of Lewiston. By this transaction a combination of all the electric light and power interests in Lewiston and Auburn will be effected.

The Edison Electric Light and Power Company, of St. Paul, Minn., is about to build a three-story addition to its transforming plant to cost $8,000. The addition will be used to take care of the surplus current and furnish a store-house that will provide power in case of a breakdown of the main plant. Improved machinery costing about $85,000 will be placed in the new structure.

Work has been started on the electric power plant which is to be constructed on the Kaw River, near Kansas City, Mo. It is said that when it is finished it will be the largest and best equipped plant in the West. It will be used by the Kansas City Electric Lighting Corporation, both for lighting and for furnishing power for manufacturing purposes. The cost will be at least $1,500,000.

ELECTRICAL SECURITIES

Of course the preeminent factor in the business situation for the week just closing is the state of unsettlement and distress into which the whole country is thrown by the terrible event of Friday at Buffalo. Naturally such occurrences tend to disturb confidence and any upsetment of existing conditions is largely reflected in the condition of the market. For several years the country has enjoyed notable and almost unexampled prosperity, and the general feeling of confidence in the existing political conditions has been enjoyed, even by those whose political propensities did not accord with the administration. Any change, therefore, must be viewed as one liable to cause an unsettled condition in the market and a downward tendency of prices in general. This may be said without any aspersion upon those who would have charge of the government in case of a fatal termination of the outrageous attack of last Friday.

This week's prices show the general falling off due to the receipt of the tragic news on Saturday, and exhibit a first symptom of the unsettlement of the market, which it is believed will not be severe or widespread. Business prosperity is so well established, and the financial interests of the country are so strong, that we have little to fear as to the future.

ELECTRICAL SECURITIES FOR WEEK ENDING SEPTEMBER 7.

New York:	Highest.	Lowest.	Closing.
Brooklyn R. T...	75½	65⅛	65⅝
Con. Gas.....	226	216½	217¾
Gen. Elec.....	267½	253	254
Man. El.....	120	114¼	114½
Met. St. Ry.....	169	162½	162½
Kings Co. Elec...	...	...	195
N.Y. & N.J. Tel. Co.	...	...	170
Telep.,Tel.&Cbl.Co.	...	...	5⅛

The first sale of the stock of the American Telephone and Telegraph Company, on the New York Stock Exchange, last week was 100 shares at 167¾.

The directors of the Commercial Cable Company have declared the regular quarterly dividend of one and three-quarters per cent, payable October 1. Transfer books close September 20 and reopen October 2.

The considerable increase in the operating expenses of the Brooklyn Rapid Transit Company for the month of July is largely due to improvements in connection with new power-houses. It is understood to be the policy of President Greatsinger to make improvements in this respect as rapidly as possible, covering this very complex system.

Philadelphia, September 7:	Closing.
Elec. Co. of Amer.....	7
Philadelphia Elec.....	5
Union Traction.....	27
United G. I. Co.....	117
Elec. Stor. Bat. c.....	71
Elec. Stor. Bat. pf.....	78

The Philadelphia *North American* announces that a project is on foot for a 100-million-dollar combination of electric railway and light companies, which will embrace Union Traction Company, the new rapid transit companies recently chartered in Pennsylvania, the Philadelphia Electric Company, the Electric Company of America and the American Railways Company. There was considerable fluctuation in stock of the Electric Storage Battery Company. The quotations fell off about five points to 71.

Boston, September 7:	Closing.
Am. Telep. & Tel.....	160
Erie Tel.....	40
New Eng. Tel.....	140
Mass. Elec. pf.....	98
Westing. Mfg. pf.....	73
Edison Elec.....	260

Chicago, September 7:	Closing.
Chicago Edison Light.....	167
Central Union Telephone.....	45
Chicago Telephone.....	274
Un. Trac.....	17
Un. Trac. pf.....	58
Metropolitan El.....	91

PERSONAL MENTION

PRESIDENT C. A. COFFIN, of the General Electric Company, has sailed for Europe.

MR. DUNCAN McNAUGHT, of the India Rubber, Gutta Percha and Telegraph Works, Ltd., of Silvertown, England, called at the ELECTRICAL REVIEW office last week.

MR. R. K. McCLUNG has been awarded an Exhibition Scholarship of 1851 by McGill University. He will go to Cambridge University to study under Professor J. J. Thomson.

MR. CAMPBELL SCOTT, secretary and general manager of the C. & C. Electric Company, has just sailed for a four weeks' business trip to Europe. Most of his time will be spent in London.

MR. WILLIAM F. L. PUFFER has been made a member of the jury of awards in the electrical division of the Pan-American Exposition. Mr. Puffer is an associate professor of electrical engineering at the Massachusetts Institute of Technology.

MR. E. M. BECKEMEN, an electrical engineer of Gretebery, Sweden, and a graduate of the Chalmers Technical College of that place, is in Pittsburgh, Pa., for the purpose of inspecting the plant of the Westinghouse Electric and Manufacturing Company.

PROFESSOR SIDNEY H. SHORT, technical director of the English Electric Manufacturing Company, Limited, whose plants are located at Preston, in Lancashire, expects shortly to visit the United States. Mr. Short is a well-known American electrical expert.

MR. HENRY RUSTIN, who executed and worked out the Pan-American illuminations which have received such great praise, is to be rewarded for his work. The Superior Jury of Awards has decided unanimously to give him a gold medal in recognition of his grand achievement.

MR. F. A. SCOTT, electrical and mechanical engineer, of Glasgow, Scotland, is one of the representatives of the English industries who are visiting this country. For the last few years Mr. Scott has been the manager for the firm of Hunter & Jack, who are engaged in mining and electric lighting and power in Glasgow.

MR. ARTHUR J. WHEATLEY, for some years chief engineer and manager of the Woking Electric Supply Company, and more recently on the staff of Mr. E. Dodd, consulting engineer of Birmingham, England, has secured an appointment under the war office to work out the details for the electric lighting of the Royal Victoria Hospital, Netley.

OBITUARY NOTICE

MR. GEORGE MASON, president of the Potomac Terra Cotta Company, of Washington, D. C., died of heart failure on September 1, after an illness of some days. Mr. Mason was a self-made man. By his own industry he prepared himself for admission to the University of Vermont, from which he graduated in 1858, and afterward received the degree of A. M. In 1863 Mr. Mason came to Washington, where he resided up to the time of his death. For the first five years of his residence there he occupied a position in the office of the paymaster-general of the army. He was admitted to the bar of the District of Columbia, and practiced his profession for several years, making a specialty of bankruptcy cases. In 1894 he purchased a controlling interest in the Potomac Terra Cotta Company, a large manufacturer of electrical conduits, and became its president.

ELECTRIC RAILWAYS

The Colonial City Traction Company, of Kingston, N. Y., has changed its name to the Kingston Consolidated Railroad Company.

The Conestoga Traction Company has begun the preliminary survey for the traction company of Conestoga, Pa., for a trolley line from Ephrata to Adamstown.

The Buffalo & Williamsville Electric Railway Company, of Buffalo, N. Y., has received a franchise from the board of aldermen of Batavia, N. Y., to lay double tracks through Batavia.

It is now said that the Indianapolis, Greenwood & Franklin Line, of Indianapolis, Ind., will be built to Nashville, and that a line will also connect with Martinsville out of Nashville.

Capitalists in Albany, N. Y., who are largely interested in traction companies, state that from within three to five years New York city and Buffalo will be connected by a double-track trolley road.

Engineers in the employ of the Connecticut Railway and Lighting Company are now engaged in surveying for the proposed extension of the local trolley line in the eastern part of Waterbury to Southington *via* Walcott.

The State Railroad Commission of New York State has granted the application of the Syracuse, Skaneateles & Moravia Railway Company, of Syracuse, N. Y., for a charter to build an electric railroad from Moravia to Syracuse.

The directors of the Canastota-Morrisville Railroad from Canastota, N. Y., have paid the $15,000 which is required by law according to a recent announcement, and the company will soon file another application for permission to build the line.

The Trenton, Lawrenceville & Princeton Trolley Extension Company, of Princeton, N. J., has reached Princeton with its new car line from Trenton. The tracks are now laid as far as Bayard lane, a few rods north of former President Cleveland's residence.

Capitalists from New York and Springfield, Mass., who are interested in the Watertown & Litchfield Trolley Company, in Watertown, Ct., have been over the proposed route. A meeting of the incorporators will be held in New Haven at an early date when an organization will be effected.

It is stated in Detroit, Mich., that the Everett-Moore Syndicate, of Cleveland, Ohio, is negotiating for the purchase of the Sanwich, Windsor & Amherstburg Electric Railway. This railway runs along the Canadian side of the Detroit River for 15 miles, and is valued at between $350,000 and $400,000.

The line of the People's Railway Company, in Wilmington, Del., will be double tracked between Wilmington and Brandywine Springs, making a double line for about five miles. In about two weeks, work will begin on the extension of the line to meet the railway which is to come from Kennett square and Westchester.

The consent necessary for a route through Vailsburg to Bloomfield into Irvington, N. J., has been obtained by the Essex-Cross Railway Company. It is stated that the company will run from Bloomfield to Irvington and finally through Elizabeth. Mr. Frank M. Epply, of West Orange, is among the stockholders in the new corporation.

The Chambersburg, Greencastle & Waynesboro, Pa., Electric Railway Company has been granted a franchise by the Waynesboro city council. The conditions of the franchise are that a forfeit of $2,500 be put up as an evidence of good faith to build the road, and that a bond in the sum of $10,000 be given, to be renewed annually.

INDUSTRIAL ITEMS

THE ROYAL ELECTRIC COMPANY, of Montreal, Quebec, has let the contract for its proposed new substation to P. Lyall & Sons, for about $100,000.

THE JOHN STEPHENSON COMPANY of Elizabeth, N. J., has obtained a good sized order for double-decked cars for the Cheltenham District Light Railway Company, of England.

THE URBAN DISTRICT COUNCIL of Ilford, England, is about to begin the construction of 11 miles of tramway. Mr. John W. Benton, clerk of the council of Ilford, will furnish the specifications.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has just placed upon the market a new cabinet-type wall telephone for both series and bridging work. Special descriptive matter is being sent upon application.

CRAMP COMPANY, of Philadelphia, Pa., has been awarded the contract for the construction of the addition to the power-house at the new plant of John Lucas & Company, at Gibbsboro, N. J. The work will cost about $40,000 and will be begun at once.

SANDERSON & PORTER, of New York, have begun the construction of the proposed power plant on the St. Joseph River, near Mishawaka, Ind. It is to cost $500,000, and is being built for the St. Joseph-Elkhart Power Company. Two years will be required to construct it.

THE ROCHESTER ELECTRICAL MANUFACTURING COMPANY manufactures the Miller cutout for the protection of fire-alarm and police telegraph boxes. At the present time much interest is being taken in this cutout. It is stated that it is simple and effective in its workings, and that it can not get out of order. Many cities throughout the country are using it at present.

THE DONNELLY IMPROVED STEEL CLIMBERS, for sale by J. J. Reidy & Company, of New Haven, Ct., are kept in stock by the Manhattan Electrical Supply Company, of Chicago, McIntosh-Huntington & Company, Cleveland, Ohio, and W. B. Belknap & Company, of Louisville, Ky. These houses will carry a very large stock of the climbers and can supply smaller dealers at factory prices.

THE EUREKA TELEPHONE COMPANY, of Chicago, after severe competitive tests, has received the contract for all telephone apparatus and supplies required by the Bradford County, Pa., Telephone Company. There will be a dozen or more exchanges built by this company, and the contract is, therefore, of considerable magnitude. The Eureka company is making a large extension to its factory facilities in Chicago.

THE LONDON COUNTY COUNCIL invites tenders up to October 8 for the supply of two 2,500-horse-power vertical system engines, each direct-connected to a continuous-current 1,500-kilowatt generator working at from 550 to 625 volts, and three auxiliary vertical high-speed enclosed steam engines of 250-horse-power, each direct-connected to a continuous-current dynamo working at from 220 to 250 volts are also required.

THE UNITED STATES BATTERY COMPANY, 522 to 558 State street, Brooklyn, N. Y., has recently published a very complete and well-illustrated catalogue of its storage batteries. The batteries are shown in use for central station electric lighting, automobiles, electric house lighting, and electric fans, also for fire-alarms and police telegraph use and railway signals. These catalogues will be of interest to every user of storage batteries and will be sent on application.

THE CONSOLIDATED ELECTRIC COMPANY, of Greenwich, N. Y., is making large additions to its hydraulic and electric plants. An entirely new concrete dam is being built which will afford a head of 52 feet. The company has also placed an order with the Rodney-Hunt Machine Company for a 400-horse-power turbine wheel, and with the Stanley Electric Manufacturing Company, of Pittsfield, Mass., for a 300-kilowatt 6,000-volt two-phase generator for direct-connection to the water-wheel, also high-tension transformers, switchboard, etc.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently taken the exclusive territorial selling agency for the new type Peerless incandescent lamps. The company states that the factory has been experimenting on this lamp for the last two or three years, and to-day has a lamp which is practically perfect, both mechanically and electrically. The success with this lamp has been extremely flattering, and the Western Electrical Supply Company is willing to send out lamps for trial to any one who desires a strictly high-grade lamp, and will guarantee them as to sustained candle-power, current consumption and life.

THE MICA INSULATOR COMPANY, of New York, N. Y., and Chicago, Ill., announces that its selling agency in Europe, hitherto entrusted to Messrs. Bergtheil & Young, 12 Camomile street, London, has ceased, and that an English company has been formed named The Mica Insulator Company, Limited, for the purpose of carrying on the European business. The principal office of the new company will be at its factory at Stansted, Essex. By uniting the selling department with the factory, the company believes that business will be facilitated by bringing it into closer touch with the market and enabling it to serve customers more promptly.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Chicago, has secured the contract for practically the entire equipment of the Keystone Telephone Company, of Philadelphia. The apparatus includes 8,000 No. 34 central energy telephones, 10,000 terminals and all other necessary protective devices. This is undoubtedly one of the largest contracts secured by an independent manufacturer and includes all but the switchboard. The reason for non-acceptance of the switchboard part was that, owing to a large number of previous contracts, the board could not have been completed within the time limit. Harrisburg is another important city in Pennsylvania, with 2,000 capacity and provision for 3,000; two small adjoining towns will have 500-line exchanges each; Reading, Pa., 1,500 central energy, with 5,000 ultimate capacity. In New Jersey, Trenton falls in line with 3,000 central energy. Ohio is well represented with Mansfield common battery 1,200 installed, with 3,000 ultimate capacity; Zanesville, 1,500 common battery connected, with provision for 3,000; in Xenia, the new exchange is running with 800 in operation, designed for 2,000. Texas has evidently realized the necessity of modern methods of communication. Austin has contracted for 1,200 central energy immediate connection, 3,000 ultimately; Temple, Tyler and Taylor, Tex., each 750 lines, central energy, ready to connect with double the capacity as subscribers increase in number; Belton, Tex., has bought a 500-line equipment, for common battery, and increase to 1,000. Oklahoma City, Indian Territory, has already 750 subscribers on a 1,200-line central energy switchboard. Topeka, Kan., will install 1,200 lines at once and provide for a certain increase up to 3,000. Rhinelander, Wis., will start with nearly 750 subscribers on a 1,200-line board. In Illinois, Pekin swells the list with a 750 to 1,200-line exchange, while in Huntington, Ind., a 1,000-line equipment is contracted for and construction under way. The American Electric Telephone Company has reason to be proud of this fine showing. Its great establishment in Chicago is one of the busiest as well as most extensive in the independent telephone field.

NEW INCORPORATIONS

DETROIT, MICH.—Detroit & Flint Railway Company. $250,000.

SAULTE STE. MARIE, MICH.—St. Marys Power Company. $100,000.

STOCKBRIDGE, MICH.—The Stockbridge Light and Fuel Company. $10,000.

MARION, OHIO—Columbus, Marion, Tiffin & Toledo Railway Company. $20,000.

ST. PAUL, MINN.—Pipestone Electric Light, Heat and Power Company. $50,000.

BELFAST, N. Y.—The Belfast Telephone Company. Capital stock increased from $1,000 to $12,000.

ALMA, MICH.—The Union Telephone Company. Capital stock increased from $25,000 to $125,000.

ATLANTIC CITY, N. J.—Chelsea Heights Traction Company. $100,000. Incorporators: Israel G. Adams, John G. Dyer and others.

HARRISBURG, PA.—The Harrisburg & Lewisburg Trolley Road. $40,000. To construct a road from New Cumberland to Lewisburg.

NEW YORK, N. Y.—Mayaguez Electric Company. $100,000. To generate electricity. Incorporators: Cecil D. Giles, Frank H. Lord and others.

GRAND RAPIDS, MICH.—The Grand Rapids, South Haven & Kala Railroad Company. $800,000. To build an electric line in western Michigan.

BALTIMORE, MD.—The Liberty Turnpike Electric Railroad Company. $150,000. Directors: Frank H. Callaway, James E. Ingram, Jr., and others.

MORRISON, ILL.—The Whiteside County Telephone Company. $20,000. To operate a telephone system. Incorporators: H. L. Hall, W. W. Warner and others.

NORFOLK, VA.—Southern Electric Supply Company. $10,000. To deal in electrical supplies. H. W. Summers, of Philadelphia, Pa., is president of the company.

WEST HAVEN, CT.—The Hogan Motor Company. $75,000. Incorporators: Frederick B. Wells, Southport, Ct.; John J. Hogan, West Haven, Ct., and others.

MILWAUKEE, WIS.—The Independent Telephone Company. $500,000. To construct a line from Escanaba, Mich., to Milwaukee. The incorporators are A. L. Hutchinson, Edwin I. Fairchild and others.

CANANDAIGUA, N. Y.—The Ontario & Wayne Traction Company. $500,000. To construct an electric railway from Canandaigua to Pultneyville. Directors: John Raines, J. L. Burnett and others.

SHEBOYGAN, WIS.—The Sheboygan-Elkhart Lake Railway and Electric Company. To construct an electric railway system from Sheboygan to Elkhart Lake. $200,000. Incorporators: John M. Saemann, Stedman Thomas and others.

BROOKLYN, N. Y.—The Northport Traction Company. $50,000. To operate an electric road between the East Northport station of the Long Island Railroad and Northport harbor. Directors: William H. Baldwin, Jr., William F. Brown, of Brooklyn, N. Y., and others.

BUFFALO, N. Y.—The Western New York Power Company. $50,000. To furnish electricity for lighting, heat and power transportation in Niagara Falls, Lockport, Batavia, Rochester and adjoining towns. Directors: Edward S. A. McLeod, Walter E. Frapton and others.

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED SEPTEMBER 3, 1901.

681,692 Electrical incandescent lamp; P. A. Gibbons, New York, N.Y.—A reflector for incandescent electric lamps consisting of a body encircled or enclosed by a filament, the surface of the body being formed of a series of prisms.

681,712 Means for controlling electric currents; P. Kennedy, Brooklyn, N. Y.

681,716 Electric circuit controller; H. W. Leonard, New York, N. Y.

681,724 Telephone exchange system; J. L. McQuarrie, Chicago, Ill.

681,725 Electrical flush receptacle and plug; W. J. Newton, New York, N. Y.

681,730 Electric piano player; T. B. Powers, New York, N. Y.

681,739 Electric igniter; F. A. Ruff, Detroit, Mich.

681,742 Connection counter for telephone lines; C. E. Scribner, Chicago, Ill.

681,743 Switchboard for telephone lines; C. E. Scribner, Chicago, Ill.

681,744 Telephone call-bell; C. E. Scribner, Chicago, Ill.

681,754 Safety device for automatic electric gas lighting apparatus; H. C. Compton, Boston, Mass.

681,763 Art of developing static electricity; Rome V. Wagner, Chicago, Ill.

681,768 Regulating and controlling electrical translating devices; G. T. Woods, New York, N. Y.—A source of electrical energy, two electro-dynamic machines whose motors are in series with each other, and whose fields are multiple with each other, the field of one of the machines being connected in series with its armature and means for controlling the speed of said machines.

681,776 Electric switch; W. F. Bossert, Utica, N. Y.

681,779 Electric clock; O. A. E. Holm, Pleasantville, N. Y.

681,780 Signal for electric railroad; H. T. Gibbs, Portsmouth, R. I.

681,860 Service meter and telephone exchanges; C. E. Scribner, Chicago, Ill.

681,862 Device for controlling the operation of electrical devices; E. Stockwell, Stamford, Ct.

681,939 Electrical musical instrument; R. L. Venuto, Kansas City, Mo.

681,941 Power shoveling device;

(Continued on page 56.)

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U. S. ENGINEER OFFICE,
735 N. Capitol St.
Washington, D. C., Aug. 24, 1901.
Sealed proposals will be received here until noon, September 23, 1901, and then publicly opened, for furnishing Electrically Driven Pumps, Cold Drinking-Water Plant, Fire Hose and Racks, and Pipe Covering for New Building for Government Printing Office. Information furnished on application.
JOHN STEPHEN SEWELL,
Capt. Engrs.

U. S. ENGINEER OFFICE,
735 N. Capitol St.,
WASHINGTON, D. C., Aug. 9, 1901.
Sealed proposals will be received here until noon, September 9, 1901, and then publicly opened, for furnishing Distributing Centers for electric lighting and power circuits for New Building for Government Printing Office. Information furnished on application.
JOHN STEPHEN SEWELL,
Capt. Engrs.

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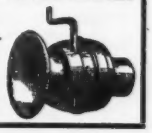
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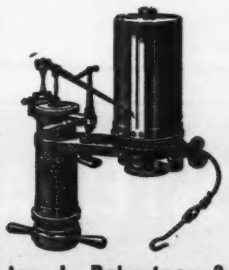
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heats water to boiling point with exhaust steam.
Jas. L. Robertson & Son, 229 Fulton Street, New York.

PATENTS.

(*Continued from page 55.*)

C. S. Westbrook, Ogdensburg, N. Y.—Consists of a shovel or scoop with a motor, a drum geared thereto, a cable from the drum attached to the shovel coactuating it and means attached to and carried by the shovel for starting the motor.

681,943 Electric switch; C. F. Ziegler, Chicago, Ill.

681,951 System of electrical intercommunication; E. A. Clark, Sioux City, Iowa—A shaft, a dial mounted thereon, a worm-wheel also mounted thereon, a worm-shaft rotating the worm-wheel, a fork mounted thereon and a contact spring adapted to be engaged by the fork.

681,957 Electric typewriter; G. S. Ennis, Troy, N. Y.

681,965 Apparatus for transforming alternating into continuous currents; Hutin & LeBlanc, Paris, France—A rotary transformer comprising an armature carrying two groups of conductors, each divided into a number of sections, corresponding to the number of commutator plates, the respective sections of the conductors being symmetrically connected to each other and to the corresponding segments of the commutator, and alternating-current inductor acting on one of the groups of armature conductors, a continuous-current conductor acting on the other group of armature conductors, and thus rotating the armature at half the speed of synchronism and stationary brushes bearing on the commutator for taking a continuous current therefrom.

681,992 Flasher for electric lamp; C. Slosser, Danville, Ill.

681,999 Art of transmitting bodies by means of electrical magnets; J. P. Swift, Pawtucket, R. I.—The process of transmitting a body or bodies from one point to another, which consists in placing a movable magnet in proper relation to a second magnet, then energizing the first magnet to cause it to attract and hold said body till brought to said second magnet and then energizing the second magnet and demagnetizing the first-named magnet.

682,006 Electrical control of flow of water to basins of washstands or lavatory bowls; I. G. Waterman, Santa Barbara, Cal.

682,007 Electromagnetic apparatus; I. G. Waterman, Santa Barbara, Cal.

682,030 Series telephone system; C. A. Casperke, Brandenburg, Ky.—A ringer coil at each station, and a condenser in multiple therewith, the condenser being included in a shunt circuit having no source of impedance therewith.

(*Continued on page 58.*)

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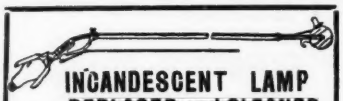
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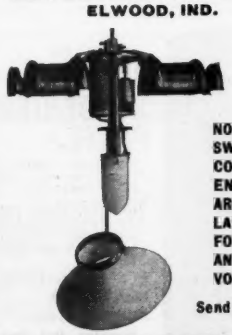
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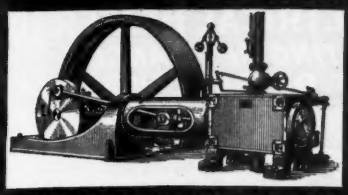

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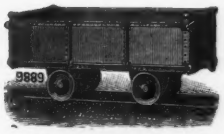

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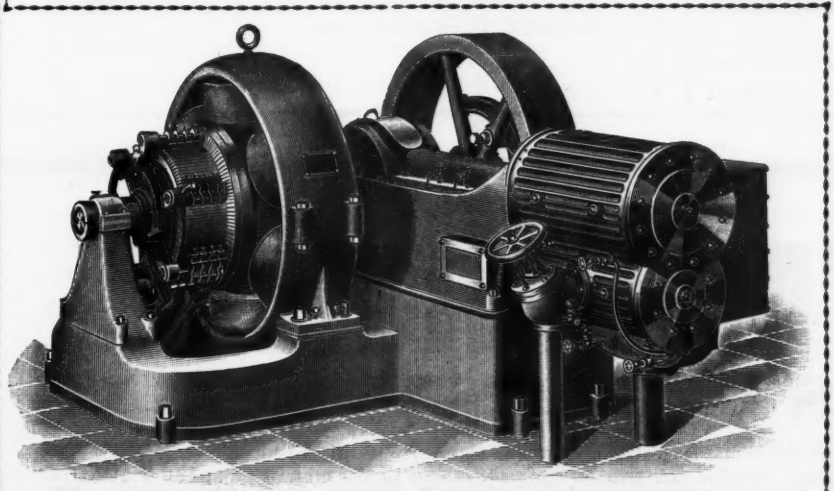

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PATENTS.

(*Concluded from page 56.*)

682,056 Contact for underground trolleys; J. S Garzousi, New York, N. Y.—A contact for underground trolleys, comprising a contact freely slidable on a plow, and having contact points at its ends to connect with the main and the return feed-wires at the different points of their length.

682,084 Electric temperature indicator; F. L. Jobson, Richmond, Va.

682,088 Electric furnace; F. A. Kjellin, Gysinge, Sweden—Comprises an annular furnace-chamber, a core of magnetic material arranged centrally thereof, and an induction coil arranged around said core and within the annular furnace-chamber, and connected to an alternating-current generator for the purpose of by said coil to induce currents to the charge of the annular chamber, sufficient for the smelting of charge therein.

682,089 Medicinal electrode; O. L. Leach, Providence, R. I.

682,093 Control of alternating-current motors; R. D. de Lignieres, Paris, France—A controller for alternating-current induction motors, having means for changing the number of poles of the motor, and means for moving the inducing field member in one direction or the other.

682,101 Arc lamp; J. C. Mayrhofer, New York, N. Y.

682,108 Time regulator for electric motors; M. M. Movshovitch, New York, N. Y.—Comprises a shaft having gear connection with the motor, a cylinder mounted on said shaft but insulated therefrom, said cylinder consisting of two compartments communicating one with the other, a liquid in the cylinder, and floats in the compartments for closing the electric circuit.

682,114 Rosette; H. T. Paiste, Philadelphia, Pa.—A rosette, having a base, a cap, means for coupling the cap to the base, and one or more screws extending through the cap and bearing upon the said coupling means.

682,116 Electric light attachment; J. H. Rusby, Nutley, N. J.

682,122 Fuse box; E. A. Wilson, Niles, Ohio.

682,152 Telephone exchange apparatus; A. B. Stetson, Malden, Mass.

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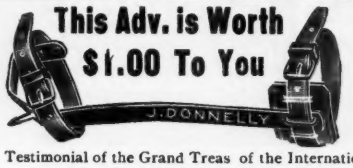

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